

台北市政府捷運工程局  
機電系統工程處  
**System-wide E&M Project Office,**  
**Department of Rapid Transit Systems, TCG**



台北捷運環狀線（第一階段）  
機電系統工程、軌道工程、自動收費系統工程  
**TAIPEI CIRCULAR LINE (PHASE 1)**  
**E&M SYSTEM, TRACK WORKS, AFC SYSTEM**  
**CF610/CF611/CF617**

				發行核定版 Issue approval version (YM-102T0804900)	NOV 11, 2014	0
A. Chen	D. Villa	J. Tsai	G. Barone			
				依業主審查意見更新 Revised in response to client's comments (YM-102T0304100)	AUG 07, 2013	D
A. Chen	D. Villa	B. Chen	G. Barone			
				依業主審查意見更新 Revised in response to client's comments (YM-101T1104800)	FEB 27, 2013	C
A. Chen	D. Villa	B. Chen	G. Barone			
				初次發行 First issue	DEC 14, 2011	A
L. Liao	D. Villa	B. Chen	R. Bruce			
編 製 Prepared (PE)	校 核 Checked (SPE)	複 核 Approved (QM)	核 准 Authorized (PD)	說 明 Description	日 期 Date	版 次 Revision

發行者： <b>Issuer</b>	安薩爾多百瑞達及安薩爾多交通號誌系統 共同承攬 <b>AB – ASTS Consortium</b>	發行者編號： <b>Issuer Code</b>
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文件名稱： <b>Doc. Title</b>	通訊系統 - 細部設計 列車通訊系統 - 細部設計 <b>COMMUNICATION – DDR</b> <b>ON TRAIN COMMUNICATION SYSTEM - DETAILED DESIGN</b>
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承攬商： <b>Contractor</b>	安薩爾多百瑞達及安薩爾多交通號誌系統 共同承攬 <b>AnsaldoBreda S.p.A. – Ansaldo STS S.p.A. Consortium</b>
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**TC1-6A201-0**

**內部修正紀錄表**  
**INTERNAL AMENDMENT LIST**

A. Chen	D. Villa	J. Tsai	G. Barone	發行核定版 Issue approval version (YM-102T0804900)	NOV 11, 2014	04
A. Chen	D. Villa	B. Chen	G. Barone	依業主審查意見更新 Revised in response to client's comments (YM-102T0304100)	AUG 07 ,2013	03
A. Chen	D. Villa	B. Chen	G. Barone	<p>依據 TC-01005-0A 「契約資料送審文件管制表」 審查意見 (YM-101T-11076-00) 更新，將子系統設備清單(TC1-6A204)與設備規格(TC1-6A205)合併並加入子系統的主細部設計文件(TC1-6A-201)成為一份文件</p> <p>Revised in response to client's comments in TC1-01005-0A "Contractual Data Submittal Control Sheet" (YM-101T-11076-00), to merge Equipment List (TC1-6A204) and Equipment Data Sheet (TC1-6A205) into main detailed design document (TC1-6A201) as one document.</p> <p>依業主審查意見更新 Revised in response to client's comments (YM-101T1104800)</p> <p>依業主審查意見更新 Revised to response client' s comments (YM-101T-11050-00)</p> <p>依業主審查意見更新 Revised to response client' s comments (YM-101T-11049-00)</p>	FEB 27, 2013	02
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L. Liao	D. Villa	B. Chen	R. Bruce	初次發行 First issue	DEC 14, 2011	00
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文件審查意見回覆表  
**RESPONSE REVIEW TRANSMITTAL**

<b>D</b>	<b>■SEMPO</b>	<b>YM-102T-08049-00</b>	<b>OCT 21, 2013</b>	<b>N1</b>
<b>C</b>	<b>■SEMPO</b>	<b>YM-102T-03041-00</b>	<b>MAY 07, 2013</b>	<b>N2</b>
<b>B</b>	<b>■SEMPO</b>	<b>YM-101T-11048-00</b>	<b>NOV 09, 2012</b>	<b>N2</b>
<b>A</b>	<b>■SEMPO</b>	<b>YM-100T-06225-00</b>	<b>FEB 08, 2012</b>	<b>N2</b>
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項次 No.	圖說/章節/項次 Drawing/ Chapter/ Item	審查意見 Review Comments	答覆 Reply Answer

<b>C</b>	<b>■SEMPO</b>	<b>YM-102T-03041-00</b>	<b>MAY 07 ,2013</b>	<b>N2</b>
<b>B</b>	<b>■SEMPO</b>	<b>YM-101T-11048-00</b>	<b>NOV 09, 2012</b>	<b>N2</b>
<b>A</b>	<b>■SEMPO</b>	<b>YM-100T-06225-00</b>	<b>FEB 08, 2012</b>	<b>N2</b>
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C1		請提列列車通訊設備符合 IEC60571 之驗證證明於工廠測試程序核准前進行。 Please provide the certification of on train communication equipment before the factory test procedure.	檢查列車通訊設備 IEC60571 之證明文件之程序將納入工廠測試程序書以確保工廠測試前該列車通訊設備符合 IEC60571。 The check of IEC60571 certificate will be included into factory acceptance test procedure in order to ensure the on train communication equipment will comply with IEC60571 before start of factory test.
C2	4.3.3.3/3.2	請提送功率放大器 Power Amplifier 設備規格文件。請詳細說明廣播功率放大器驅動列車 (A/C/D/BCar) 之配置方式。Please provide Power Amplifier equipment specification document . Please explain the car's configuration of public address power amplifier .	新增功率放大器規格於第 68 頁，並新增圖 4-1 說明廣播功率放大器配置方式。 Added Power Amplifier Specifications on p.68, and Figure 4-1 illustrates the added Power Amplifier configuration.
C3		3.3.1 內文，...請參考圖 3-10 錯誤，請更正。3.6 內文，(由低等級制高等級)錯誤請更正，並說明操作模式包含兩等級之內容。In Sec 3.3.1 , please revise the Figure 3.10 . In Sec 3.6 (from the lowest priority to highest priority ) please revise the wrong part , and explain the operation mode include 2 priorities .	3.3.1 內文已修正錯誤內容。3.6 內文已修正錯誤內。容低等級操作模式內容如 3.6.1 內文。高等級操作模式內容如 3.6.2 內文。 3.3.1 content contents of the error has been corrected. 3.6 content contents of the error has been corrected The operation model of low priority is in 3.6.1 context. The operation model of high priority is in 3.6.2 context.
C4	3.2	3.2 廣播的操作模式 4 透過服務對講機傳送...，內文中服務對講	服務對講機(SI)為手持式喇叭麥克風。新的廣播會直接取代現有

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		<p>機所指為何?另每一個等級的特性說明第 3 項:請說明是否等現有廣播完成再播新的廣播,請說明。</p> <p>In Sec 3.2 , the operation mode 4 of public address , live announcement made through the service intercom , means what service intercom ? The characteristics of Priority modes 3 : Please explain whether broadcast the new public address after the current public address finished?</p>	<p>的廣播。</p> <p>Service Intercom (SI) is Handheld Speaker Microphone. New Announce broadcast will replace present broadcast directly.</p>
C5	P56	<p>列車通訊設備文件中表示透過 DCS 網路傳回行控中心,惟 TRIU 設備屬 TETRA 系統,該系統依 SDH 技術文件所提供,請釐清並詳細說明列車各通訊設備回傳行控中心,透過傳輸設備之路徑。</p> <p>The on train communication equipment document means through DCS network returns to OCC , only TRIU belongs TETRA system , and provide by SDH document , please clarify and explain the transmission equipment path of each on train communication equipment through OCC .</p>	<p>已修改圖 3-17 及新增表 3-7,請參閱第 55 頁內容。</p> <p>Modified figure 3-17 and added table 3-7. Please see p.55.</p>
C6		<p>請提供列車網路路由器保護機制為何?請用圖示模擬各車廂路由器故障,保護方式如何啟動。</p> <p>Please provide the on train network router protection .Using illustration to simulate how to start the protection of each car's router failure .</p>	<p>列車網路路由保護機制為 RSTP 並新增圖 3-16</p> <p>Train network routing protection mechanisms RSTP, relevant content to add figure 3-16</p>
C7	P67	<p>圖 4-1 列車無線電方塊圖顯示所有信號係透過 DCS 網路回傳行控中心,與 SDH 傳輸系統技術文件 TETRA 系統為該系統所提供,請說明行控與數位無線電傳</p>	<p>已修改圖 4-2。CC 訊號透過 DCS 網路傳至 TRIU 為單向資料傳輸。相關傳輸路徑請參考圖 3-17</p> <p>We modified figure 4-2. The data</p>

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		<p>輸路徑及動作原理。</p> <p>Figure 4-1 block diagram of TRIU shows that all signal through DCS network return to OCC , and provide the SDH system document TETRA system provide , please explain the transmission path and action principle of OCC and digital radio .</p>	<p>transmission between DCS network and CC is single way. Related transmission path please refer to figure 3-17</p>
C8	P87	<p>列車 cctv 的 DVR 時間與母鐘同步，透過 DCS 網路來校正，惟 GE 傳輸系統技術文件顯出時鐘系統係由該系統所提供，請釐清並說明行控與列車同步傳輸路徑及動作原理。</p> <p>On train DVR's time is synchronization with the master clock , and correct through DCS network , but the GE system document shows that the clock system is provide by it . Please explain the transmission path and action principle of OCC and train synchronization.</p>	<p>列車同步傳輸路徑為 DVR 向 VCS Server 校時，VCS Server 向 CMFT Server 校時,詳細同步做原理請參考 TC1-69201 閉路電視系統 - 細部設計 第 14 章。</p> <p>The synchronization path is: DVR synchronized via VCS Server, VCS Server synchronized via CMFT Server. Please refer to the TC1-69201 CCTV DDR Section 14 for more detail.</p>



<b>B</b>	<b>■SEMPO</b>	<b>YM-101T-11048-00</b>	<b>NOV 09, 2012</b>	<b>N2</b>
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B1	3.7/Page- 55	<p>網路交換器與各車廂的網路交換器彼此相互連接，但其並無備援機制，倘若 C Car 的 Ethernet Switch 損壞，是否意味著列車 A 車廂與 D、B 車廂主幹網路連接即產生中斷？請釐清。</p> <p>The Ethernet switches of each car are connected to each other, but there's not redundant mechanism. Whether the Ethernet switch of car C is broken, the trunk network between car A, car B and Car D is interrupted?</p>	<p>網路交換器以環型方式聯接，任一車廂網路交換器損壞皆不會影響其他網路交換器之正常運作，主幹網路連接持續正常運作。</p> <p>The Ethernet Switch use ring structure to connect , each Ethernet Switch broke can not affect the trunk network normal operation .</p>
B2	7/Page-86	<p>A 車網路交換器故障，TRIUI 會將主控端轉移至 B 車；B 車網路交換器故障亦會相同轉移主控端至 A 車，倘若 C 或 D 車網路交換器故障時，其情形如何請補充說明。</p> <p>As the Ethernet switch of car A has a breakdown, TRIUI will shift the master end to car B. And as the Ethernet switch of car B has a breakdown, TRIUI will also shift the master end to car A. Please supplement the situation that the Ethernet switch of car A/car C has a breakdown.</p>	<p>C 或 D 車網路交換器故障時，TRIUI 主控不會切換，列車網路除該網路交換器所直接連接之設備外，其餘設備仍可正常運作。</p> <p>As the Ethernet switch of car C or car D has a breakdown, the master end of TRIUI won't shift. And except the equipment directly connect to the switch, the other equipment can still work normally.</p>
B3	GENERAL	<p>TETRA 無線電天線駐波比，請設計 <math>VSWR \leq 1.5</math>，以利無線通訊品質。</p> <p>In order to facilitate wireless communication quality, please design TETRA antenna <math>VSWR \leq 1.5</math>.</p>	<p>車機原廠建議搭配的多款天線，其 <math>VSWR</math> 皆為 2，亦即在 410~430MHz 頻段內，<math>VSWR</math> 介於 1~2 之間。</p> <p>The <math>VSWR</math> are 2 of the antennas recommended by the TROU manufacturer. This</p>

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			represents in frequency 410~430MHz, VSWR is between 1 and 2.
B4	P65	<p>細部設計-設備規格文件之原廠詳細規格說明顯示 TETRA 無線電天線規格頻率為 400-420MHZ，惟注釋說明：“為本捷運工程專案電聯車特別提供頻帶 410~430MHZ 之天線”。請將此注釋註明於本文中。</p> <p>The original specification of TETRA antenna shows that the antenna frequency is 400-420MHz, but it also provides explanatory notes: "For EMU of this MRT construction project, the antenna is specially provided of 410 ~ 430 MHz." Please state the note in this article.</p>	<p>遵照辦理。已標註“為本捷運工程專案電聯車特別提供頻帶 410~430MHZ 之天線”於附件三 TETRA 無線電天線。</p> <p>Noted. Has noted "For EMU of this MRT construction project, the antenna is specially provided of 410 ~ 430 MHz." in Appendix 3 TETRA RADIO ANTENNEA SPEC .</p>



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A1	GENERAL	<p>當車廂內乘客使用緊急對講機，行控中心閉路電視系統監視畫面，自動連動切換至該車組上，該切換監視畫面邏輯，請送審。</p> <p>When the passenger use PI in a car, the CCTV system's monitoring screen in CC can switch to that car automatically. Please submit the logic of monitoring screen switching for review.</p>	<p>知悉。請參考 TC1-67201 通訊多功能操作台-細部設計，第2章節-列車連動監看。</p> <p>Noted. Please refer to TC1-67201 Communication Multi Function Terminal –detail design, the section 2 ON-TRAIN INTERLOCKING MONITOR.</p>
A2	GENERAL	<p>緊急對講機，請設置通話時之燈號顯示、聲音警示功能。</p> <p>As PI carry on a conversation, please set the function of light display and sound alarm on PI.</p>	<p>緊急對講機設置有通話時之LED顯示及待接警示音(ring back tone)功能。</p> <p>As PI carry on a conversation, there is function of LED display and ring back tone on PI.</p>
A3	GENERAL	<p>車廂緊急對講機（含輪椅區）設置高度，及於車門間配置設計請送審。</p> <p>Please submit the setting height of PI (Including in the wheelchair position) and the placement between car doors for review.</p>	<p>將提供於 TC1-6A203 列車通訊 - 安裝設計 (纜線圖、接線圖，機櫃設備配置與安裝方式)及 TC1-D3-566 細部設計-車輛內裝配置。</p> <p>To be provided in TC1-6A203 On Train Communication - Installation Design (Cabling and Wiring Diagram, Rack Layout and Mounting).and TC1-D3-566-DDR-PIDS Installation Layout</p>
A4	GENERAL	<p>電聯車車廂廣播設計，設計須以廣播喇叭音場播放均衡為原則，請採納廣播喇叭配置於天花板上之設計方式。</p> <p>In principle, the design of on-train PA should make the sound field of speakers balanced. Please adopt the design by setting the speakers above the ceiling.</p>	<p>喇叭配置於天花板，詳細圖說將提供於 TC1-6A203 列車通訊 - 安裝設計 (接線圖，機櫃設備配置與安裝方式) 及 TC1-D3-551 細部設計 - 車輛內裝 Speaker will install on ceiling and the detail drawing will provide in On Train Communication - Installation Design (Cabling and Wiring Diagram, Rack Layout and Mounting) and TC1-D3-551-DDR-Vehicle Interior</p>
A5	GENERAL	<p>服務對講機請設計耳機功能。</p> <p>Please design the function of headset for SI.</p>	<p>SI 的麥克風和對講機於 TRCP 面板上均有音量調整鈕可以調整音量大小。SI 將提</p>

			<p>供 3.5Φ 耳機孔，惟廠商將不另提供耳機及其相關配件。</p> <p>SI's microphone and speaker have volume control on TRCP. SI will provide 3.5Φ headphone jack, but will not provide headphone or other related fitting</p>
A6	GENERAL	<p>車內旅客資訊顯示系統（PIDS）細部設計，請於電聯車資訊顯示系統補提送審。另 PIDS 傳輸，其區域無線網路標準為何？</p> <p>Please submit the detail design of PIDS in the train information display system for review. And what's the standard of the regional wireless network ?</p>	<p>1.遵照辦理。</p> <p>2.PIDS 使用 RS-422 傳輸至 N-PORT 後，連接至網路交換器。</p> <p>3.CMFT 伺服器會透過 TETRA 數位無線通訊網路將訊息傳送至列車的 PIDS.</p> <p>1. Noted</p> <p>2. PIDS use RS-422 to transmit to N-PORT than connect to Network switch.</p> <p>3.The CMFT server will send the PIDS message through TETRA communication network.</p>
A7	GENERAL	<p>TETRA 無線電天線之全頻段駐波比（VSWR）設計為何？</p> <p>Please interpret the VSWR design of the TETRA antenna.</p>	<p>於 TETRA 申請核准使用之無線電頻率，其對應頻率之天線設計 <math>VSWR \leq 2</math>。</p> <p>Corresponding to the TETRA frequency for approval to use, the <math>VSWR \leq 2</math>.</p>
A8	GENERAL	<p>列車通訊設備安裝位置及方式，請送審。</p> <p>Please submit the install location and method of OTC equipment for review.</p>	<p>詳細圖說將提供於 TC1-6A203 列車通訊 - 安裝設計 (纜線圖、接線圖、機櫃設備配置與安裝方式)。列車設備位置圖說請參考：TC1-D3-416 細部設計-車內外低電壓設備箱、TC1-D3-551 細部設計-車輛內裝配置、TC1-D3-566 細部設計-旅客資訊顯示系統安裝配置、TC1-D3-421 細部設計-緊急駕駛位置操作台配置。</p> <p>The detail drawing will provide in On Train Communication - Installation Design (Cabling and Wiring Diagram, Rack Layout and Mounting). For the detailed mounting drawings of the equipments in the EMU please refer to the following documents : TC1-D3-416-DDR-Internal and External</p>

			LV Boxes TC1-D3-551-DDR-Vehicle Interior、TC1-D3-566-DDR-PIDS Installation Layout、TC1-D3-421-DDR-Emergency Driving Position-Console Layout
A9	GENERAL	列車通訊設備軟體設計為何？請送審。 Please submit the software design of OTC equipment for review.	將提供於 TC1-6A206 列車通訊 - 系統軟體 文件中。 Will be provided in "On Train Communication - System Software".
A10	3.2.3	操作流程第 1 項句尾描述"CMFT 將不會允許操作員進行預錄廣播"。應是"口語廣播"。另請確認 OCC 之口語廣播與列車上 SI 口語廣播及 CC 預錄廣播之優先次序。  The first one of the operation flow describes that CMFT will not allow OCC operator to make live audio announcement. It should be live announcement. And please confirm the priority of OCC live announcement, SI live announcement on car and CC predefined audio messages.	1.知悉，已修正。 2.SI 口語>OCC 口語>CC 預錄廣播。 1.Noted Has revised. 2.The order of priorities is : SI live Announcement>OCC live announcement>CC predefined audio messages.
A11	表 3-2/P14	TRCP 無線電功能列表，其中群組選擇建之直通模式（DMO）之功能描述說明「終端設備之間的直接無線電通信，不須要經過 TETRA 網路」，請說明此處無線通信非經由 TETRA 傳輸，係由何種設備進行網路傳輸。  In the TRCP radio function, the DMO of the group selection describes that the radio direct mode operation between terminal equipments is not through TETRA. What kind of network to communicate if the wireless communication here is not through TETRA?	DMO 模式不需透過 TETRA 的基地台網路進行通訊，直接進行設備間之通訊。 DMO is direct radio communications between terminal equipment without the TETRA Base Station Network.
A12	3.1.1/P15	有關本文說明駕駛員在手動駕駛模式，可在 TRCP 面板操作的無線電功能，可在 TRCP 面板操作的無線電功能，其中包含在手動駕駛模式下，接聽來自旅客緊急對講機的通話。請補充說明，當駕駛員與車內旅客通訊時，該通訊內容於行控中心（OCC）通訊多功能操作台（CMFT）如何喜善該通話模式（OCC 是否可監聽），另車內及 OCC 是否有錄音裝置。  The train operator in manual mode can operate the radio functions in the TRCP. And the radio functions contains the answering of emergency intercom calls from passengers. As the train operator	在手動駕駛模式下，駕駛員已獲取 PI 接聽權限： 1.CMFT 應顯示該列車已授權駕駛員接聽 PI 2.SI 接聽 PI 通話時，OCC 端無法監聽與錄音。 3.由於本系統在 CDR 概念設計階段並未納入考量，並無車上錄音功能。 In manual mode, the driver has already get the permission of PI answering. 1. CMFT should show that the train has already authorized the driver

		<p>carry on a communication with the passenger, how the content of that communication display on CMFT in OCC ? (Whether OCC can monitor ? )</p> <p>And are there any recording devices in the car and OCC ?</p>	<p>answering PI.</p> <p>2. As SI answering the PI call, OCC can't monitor and record.</p> <p>3. Because the system did not consider the recording devices on the car when conceptual design stage , so does not have record function on the car .</p>
A13	3.2.1/P21	<p>有關由車載控制器 CC 傳來的預錄廣播訊息內容將存於 TRIU (TETRA 無線電界面單元) 裡。「TRIU 將提供 200MB 儲存容量儲存列車預錄廣播的訊息內容和乘客資訊顯示內容文字」, 請補充說明該容量約可儲存多少文字內容 (請量化), 另硬體可否擴充儲存容量, 上限為多少。</p> <p>The predefined audio messages requested by CC are stored in TRIU. TRIU will provide 200MB capacity to store the content of predefined audio and predefined text message of PID. Please supplement 200MB can store how many texts. (Please quantify) And whether the hardware can expand storage?(What's the upper limit?)</p>	<p>1. 1MB 可以儲存約 50 萬個中文或英文字元 (Big 5 編碼格式)。</p> <p>2. 1MB 約可儲存 47 秒語音 ( 22050Hz 、 8 bits 、 Mono )。</p> <p>3. 硬體可擴充容量, 目前最大上限為 16GB。</p> <p>1. 1MB can store fifty thousand Chinese and English character. (Big5 code)</p> <p>2. 1MB can store voice about 47 seconds.(22050Hz 、 8 bits 、 Mono)</p> <p>3. The hardware can expand storage. The maximum limit is 16GB.</p>
A14	圖 3.5 、 3.6/P24 、 P25	<p>有關車廂喇叭安裝位置及音壓量測點位置相關意見如下：</p> <ol style="list-style-type: none"> <li>有關車廂喇叭設置位置 SP1~SP12, 請確認該設置位置與電聯車相關設備, 如空調機組、照明設備、扶手、出風口...等並無干涉。另請提供喇叭設置位置詳細圖說 (含各位置尺寸及立面圖)。</li> <li>請於圖說上標示各量測點 A~N 位置尺寸 (平面位置及高度), 另請說明該量測點, 若旅客站立之高度不同, 其音壓是否會改變?</li> <li>有關廣播語音聲壓計算所列之量測點, 並未包含車間通道, 請增列。</li> </ol> <p>The comment about the position of on-train speakers and the position of SPL measurement is following:</p> <ol style="list-style-type: none"> <li>Please check position of on-train speaker about SP1~SP12 that does not interfere with train equipments ex. air conditioning, light, handrail etc. Please provide detail drawing about position of speakers.</li> <li>Please show dimension of position A to N in drawing. And description</li> </ol>	<p>1.已確認喇叭位置並不影響列車上其它相關設備。詳細喇叭位置圖, 將提供於 TC1-6A203 列車通訊 - 安裝設計 (纜線圖、接線圖, 機櫃設備配置與安裝方式)。</p> <p>2.各量測點之音壓設計考量 worse case 條件, 旅客站立高度位置不同音壓會稍有變化, 但正常高度下均符合最低音壓強度之需求。</p> <p>3.車間通道之音壓計算已納入技術文件本文第 3.2.5 節。</p> <p>1. The location of speakers are confirmed without any interference with other relevant on train devices. The detail SPEAKER drawing will provide in On Train Communication - Installation Design (Cabling and Wiring Diagram, Rack Layout and Mounting).</p> <p>2. Consider the worst case</p>

		<p>for sound pressure changing the height of passengers. Please add test point of PA pressure changing for passageway.</p>	<p>for acoustic speakers pressure design at each point, there's a little variance vary with the height of passengers. And each point is accord with the least SPL demand in normal circumstances. 3. The calculation of acoustic speaker pressure in train-aisle has been include in section 3.2.5 of C1-6A201-A COM DDR.</p>
A15	3.3.1/P29~31	<p>有關旅客利用緊急對講機（PI）與 OCC 進行全雙工語音通訊，相關意見如下：</p> <ol style="list-style-type: none"> <li>有關當 OCC 與旅客緊急通訊時，該通訊內容是否有雙向錄音（車內與 OCC）裝置。</li> <li>當 OCC 與車內旅客緊急通訊時，若該列車配有列車駕駛員時，列車駕駛員可否於手動駕駛控制台同步得知 OCC 與 PI 知通訊內容。</li> </ol> <p>The comment about that passengers are required to have full duplex voice communication with OCC operator by using PI is following:</p> <ol style="list-style-type: none"> <li>As OCC communicate with PI, is there a two-way(in car and OCC) call recorder to record this communication ?</li> <li>As OCC communicate with PI, whether the on-train operator can learn the content of this communication synchronously by operating the on-board communication system in the manual mode.</li> </ol>	<ol style="list-style-type: none"> <li>僅 OCC 端有雙向錄音裝置。</li> <li>當 OCC 與車內旅客緊急通訊時，駕駛員無法得知 OCC 與 PI 之通訊內容。</li> </ol> <ol style="list-style-type: none"> <li>There's only one two-way recorder in OCC.</li> <li>As OCC communicate with PI, the on-train operator can't learn the content of this communication.</li> </ol>
A16	3.3.3/P32~33	<p>有關 OCC 操作員可使用 CMFT 的監聽喇叭，經由 PI 監聽特定的列車上的旅客動態，請說明車內監聽設備係與 PI 結合，或利用其他設備。另於 OCC 及車內是否有監聽儲存裝置，請補充。</p> <p>To monitor the passenger activities in the specific train, the OCC operator can use the monitor speaker of CMFT to listen the specific train situation through the all the PI(s) of the train. Please interpret whether the monitoring equipment is combined with PI or using other equipment. And are there any monitoring storage equipment in the car and OCC?</p>	<ol style="list-style-type: none"> <li>車內監聽功能由 OCC 操作員選擇啟動，透過 TETRA 無線電啟動 PI 監聽功能，並無其他監聽儲存裝置。</li> <li>僅 OCC 有監聽儲存裝置。</li> </ol> <ol style="list-style-type: none"> <li>The function of in-car monitoring is activated selectively by the OCC operator. And the monitoring by PI is through TETRA. There's no monitoring storage equipment in the car.</li> <li>The monitoring storage equipment is only in OCC.</li> </ol>
A17	3.4.2/P36	<p>有關列車駕駛員可透過服務對講機（SI）進行對全列車的口語廣播，請說明 OCC 可否同步得知列車駕駛員進行口與廣播之內容。</p>	<p>OCC 無法得知列車駕駛員進行口語廣播之內容。 OCC can't learn the content of the live announcement</p>



		The train operator can have a live announcement to on-train speakers through the SI. Please supplement whether OCC can learn the content of the live announcement from the train operator.	from the train operator.
A18	5.2/P63-64	有關 OTC 網路交換器的埠數，請補充說明網路交換器係供應多少埠數以供串接使用，另是否提供備用知埠數。  Please supplement that the OTC Ethernet switch provides how many ports to connect in series. And whether the switch provides alternative ports ?	各網路交換器提供 8 埠用以連接各設備，2 個超高速乙太網路埠用以串接網路交換器；於 A、B 列車之第二台網路交換器有預留 5 埠備用，C、D 列車預留 3 埠備用。  Each network switch has 8 ethernet ports for connect to each equipment and two Gigabit Ethernet ports for switch connection. The switch 2 of A and B car will has five ports for spare. The C and D car will has three ports for spare.
A19	表 5.2/P63	有關表 5-2：OTC 網路交換器的埠數使用需求列表，相關意見如下：  1. 因列車各車廂係提供 3 組乘客對講機 PI，故有關 PI 於各車廂網路交換器的埠數，請澄清未何 A、B 車相提供 4 個，C、D 車廂提供兩個，其網路埠不等於各車廂 PI 提供之數量。  2. 因 C、D 車廂係提供 2 個網路埠，供車內 3 組 PI 使用，故該車廂之 PI 是否有共用同一網路埠知情形，請釐清說明，另是否會影響其通話功能。  Table 5-2 : The requirement of OTC Ethernet switch ports list. And the following is the relevant comment. 1. Each car provides three sets of PI. Car A and car B provide four Ethernet switch ports. Car C and car D provide two Ethernet switch ports. Please clarify why the Ethernet switch port isn't consist with the number of PI.	1. PI 於各車廂網路交換器的埠數與 Wiring Diagram 相符 (4-2-2-4)。  2. 沒有共用同一網路埠，故不會影響其通話功能，請參考 TC1-6A202 細部設計圖。  1. The Ethernet switch ports for PI correspond to the wiring diagram.(4-2-2-4)。  2. PI uses the different network port, and there is no influence on the function of communication.
A20	表 5.5	有關表 5-5：OTC 設備的電源消耗需求，請補充 OTC 設備提供知總電源功率 (W) 為何。  Table 5-5 : The power consumption of each OTC equipment. Please supplement the total power of the OTC equipment.	已補充內容，一列車總消耗電源功率為 4240W，請參考表 5-5。  Has supplemented the content. A train of total consumption power is 4240W. Please refer Table 5-5.
A21	3.4.3/P37	SI 與 PI 語音通道應比照 OCC 與 PI 模式，以全雙工設計模式提供旅客緊急通話服務。	SI 必須搭配 TETRA 車機使用 PTT 功能，故無法設計全雙工模式。

		The voice channel between SI and PI should accord with OCC and PI, using full duplex mode to provide service.	For working the PTT function, SI should use with TROU. Due to the SI's hardware limitation, SI only can provide half-duplex voice communication.
A22	GENERAL	OCC 與駕駛員（手動駕駛模式）回覆旅客緊急通需求，其使用之發話器為 PI 喇叭、單節車廂喇叭或全列車喇叭，請補充說明。  Please supplement which is OCC and the train operator used to answer the request of PI, the PI speaker, the PA speaker in single car or PA speakers on the train.	發話器為 PI 喇叭。  The speaker of train operator used to answer the PI request is PI speaker.
A23	GENERAL	OCC □/錄播、駕駛員口播、CC 錄播、SI-OCC、PI-SI...等功能，請列表彙整優先等級及其影響其他功能說明。  For the communication (Ex: OCC broadcast, the train operator broadcast, CC broadcast, SI-OCC, PI-SI), please compile the priority list and interpret the effect on other function.	於本文第 3.8 節中增列。 Added. Please refer to section 3.8 .
A24		內文提供圖面不清楚，請更新。 The drawing size in the document is not clear. Please renew the content.	圖面已更新。 The drawing has been updated.
A25	P48	每組列車前後...提供一組 TETRA 無線電車機，請提供擺放位置圖，請補充。  Please supplement the place diagram of TROU in each manual driving console.	將提供於 TC1-6A203 列車通訊 - 安裝設計 (纜線圖、接線圖，機櫃設備配置與安裝方式)。  Will be provided in On Train Communication - Installation Design (Cabling and Wiring Diagram, Rack Layout and Mounting)
A26		請於本文件專章說明，有關列車於測試軌進行測試時，測試軌監控台如何監控車內列車通訊系統運作情形（含故障監控），另列車通訊系統相關傳輸於 OCC 是否仍能監控。  Please dedicates a chapter to explain as conducting the train-test on the testing tracks, how the monitoring station of testing track monitor the OTC system operating situation. (Including fault monitoring.) Could OCC monitor communication about OTC system?	TRIU 每隔 30 秒透過 TETRA 網路傳送 OTC 設備狀態給 OCC 端。  TRIU transmits the status of OTC equipment through TETRA Radio communication network every 30 seconds.
A27	3.4.1/P34	手動駕駛模式下，駕駛員使用 OCC CALL 功能與 OCC 通話時，其列車到站訊息廣播仍應提供服務。  During the manual mode operation, the train operator use function "OCC CALL" to call OCC, the broadcast of train	駕駛員使用 OCC CALL 功能與 OCC 通話時，列車到站訊息廣播仍可提供服務。  As the train operator use "OCC CALL" to call OCC, the broadcast of train arrival



		arrival should still provide service.	can still provide service.
A28	7/P69	<p>有關系統備援功能，請補充說明 TRIU 主副控自動切換功能如何驗證？並提供 Redundancy 之 Remote Control 功能。</p> <p>For the system redundancy, please interpret that how to verify TRIU can switch between the master and slave mode automatically. And provide the Remote Control function of redundancy.</p>	<p>1.當 Slave TRIU 無法正常取得 Master TRIU 的狀態或 Master TRIU 狀態異常時，Slave TRIU 則自動變成 Master TRIU。</p> <p>2. 可達成 Redundancy 的 Remote Control 功能。</p> <p>1. As Slave TRIU can't get the status of Master TRIU and Master TRIU is in state of exception, Slave TRIU can switch to Master TRIU automatically.</p> <p>2.The Remote Control function of redundancy can be achieved.</p>
A29	附件 1.P6	<p>TCI-6A205 文件未見耳機功能，請補充。</p> <p>There's no head-set function in the TCI-6A205 document. Please supplement.</p>	<p>SI 的麥克風和對講機於 TRCP 面板上均有音量調整鈕可以調整音量大小。SI 將提供 3.5Φ 耳機孔，惟廠商將不另提供耳機及其相關配件。</p> <p>SI's microphone and speaker have volume control on TRCP . SI will provide 3.5Φ headphone jack ,but will not provide headphone or other related fitting</p>
		<p>以下空白</p> <p>Following is blank.</p>	

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## 1 範圍 SCOPE

### 1.1 目的 PURPOSE

本文件提供台北捷運環狀線（第一階段）專案通訊系統細部設計。

This document provides the Detailed Design of the On Train Communication system for the Taipei Circular Line (Phase I) project.

本文件將提供列車通訊系統設備功能與技術規格，包含了設備外觀、型號及相關的模組，也包含了設備數量及規格。

The document will provide system equipment functions and technical specification of the On Train Communication System, including the appearance of the equipment, model and the related modules, also including the equipment quantities and datasheets .

### 1.2 適用性 APPLICABILITY

本文件適用於台北捷運環狀線計畫第一階段。

This document is applicable to the Taipei Circular Line Project phase 1.

### 1.3 參考文件 REFERENCE DOCUMENTS

下述文件為計畫性文件，為本送審文件之參考依據，任何下述之法規及標準皆將依 GS 1.5.1(4)之規定提送。

The following are project documents which serve as references for this document.

Any regulations and standards listed below shall be submitted according to GS 1.5.1 (4).

- (1) 台北捷運機電系統 一般規範 01704 1.7.6 (2)B  
TRTS E&M GS 01704 1.7.6 (2)B
- (2) CF610 機電系統標特別技術規範 16004 §2.4.10  
CF610 E&M System PTS 16004 §2.4.10

### 1.4 名詞、略語、縮寫 TERMS, ACRONYMS AND ABBREVIATIONS

PA	廣播 Public Address
AT	自動電話 Automatic Telephone
ATC	列車自動控制 Auto Train Control
CC	列車控制器 Carbone Controller
CCTV	閉路電視 Closed Circuit Television
CMFT	通訊多功能操作台 Communication Multi Function Terminal
DCS	數據通訊系統 Data Communication System
DI	數位輸入控制 Digital Input
EMU	電聯車 Electric Multiple Unit
GE	超高速乙太網路 Gigabit Ethernet Network
GUI	圖形使用者介面 Graphic User Interface

IP*	網路協定 Internet Protocol
LAN	區域網路 Local Area Network
NTP	網路定時協議 Network Time Protocol
DHCP	動態主機設定協定 Dynamic Host Configuration Protocol
DMO	直通模式 Direct Mode Operation
DVR	數位影像錄影機 Digital Video Recorder
OCC	行控中心 Operation Control Center
OTC	列車通訊 On Train Communication
PI	旅客緊急對講機 Passenger Emergency Intercom
PID	旅客資訊顯示器 Passenger Information Display
PIDS	旅客資訊顯示系統 Passenger Information Display System
POE	乙太網路供電 Power over Ethernet
SDS	短數據服務 Short Data Service
SDH	同步數位階層 Synchronous Digital Hierarchy
SI	服務對講機 Service Intercom
TETRA	地面中繼式無線電 Terrestrial Trunked Radio
TRCP	TETRA 無線電控制平台 TETRA Radio Control Panel
TRIU	TETRA 無線電介面單元 TETRA Radio Interface Unit
TROU	TETRA 無線電車機 TETRA Radio Onboard Unit
TRTC	台北捷運公司 Taipei Rapid Transit Corporation
TRTS	台北捷運系統 Taipei Rapid Transit System

**1.5 自前版次變更說明 DESCRIPTION OF CHANGES FROM PREVIOUS REVISION**

□首次發行無內容 Not applicable for the first issue.

■已納入下列修訂 The following modifications have been introduced:

說明 Description	修訂段落 / 頁面 Modified paragraph / page
依業主審查意見更新(YM-102T-08049-00 dated OCT. 08, 2013) Revised in response to client's comments (YM-102T-08049-00 dated OCT. 08, 2013)	修訂 3.3.1, 3.3.2, 3.4.3 章節 新增附件 10 Amendment section 3.3.1, 3.3.2, 3.4.3 Added Appendix 10



## 2 系統概述 SYSTEM DESCRIPTION

- (1) 列車通訊透過 TETRA 無線電車機(TROU)將無線電訊號傳送至 TETRA 基地台，經由通訊光纖傳輸系統之同步數位階層系統(SDH，Synchronous Digital Hierarchy)將訊號傳送至行控中心。TETRA 無線派遣台和基地台屬於數位無線電系統。

On-Train Communication uses TETRA Radio Onboard Unit to transmit radio signal to TETRA Based station through SDH system of FOT System to OCC. TETRA Dispatcher and base station belong to Digital Radio System.

- (2) 數位無線電系統，涵蓋整體路網，供營運人員雙向之無線語音和數據通訊使用。

Digital Radio System covers the overall network for service operators to use radio audio and data communication.

- (3) 原則上，列車之語音傳輸通訊如喇叭廣播、服務對講機及緊急對講機..等使用 TETRA 無線電系統通訊。列車無線電通訊設備通過 TETRA 標準相容性測試 (Inter-Operability Test)；列車上通訊設備符合 IEC 60571 或同等級之規定。

In principle, the on-board audio communication devices, such as loudspeaker, service intercom, and passenger intercom, etc will adopt TETRA radio system. The on-board radio communication devices will pass the inter-operability test of TETRA standard. The on-board communication devices shall conform to IEC 60571 standard or the parallel regulations.

- (4) OCC 派遣台和 CMFT 操作台將可顯示所通訊之列車的列車識別碼顯示於上，且 OCC 派遣台和 CMFT 操作台都可以執行環狀線列車之所有語音通訊。

OCC dispatcher and CMFT console can be able to display ID code of train communicated, and OCC dispatcher and CMFT console can perform all voice communication with all trains in Circle Line.

- (5) 在 OCC, CMFT 與列車操作介面設備將包含 CMFT 操作台、麥克風和喇叭和頭戴式耳機麥克風。其 CMFT 列車操作的概念性使用模式如下

(A)當列車啟動 PI 或 SI 功能時，操作員可以於 CMFT 操作台看到 PI 或 SI 來電訊息並可以使用麥克風和喇叭或是頭戴式耳機麥克風與列車通話。

(B)當操作員於 CMFT 操作台啟動列車監聽功能時，操作員可以使用喇叭，監聽到從列車 PI 的聲音。

(C)當操作員於 CMFT 操作台啟動列車廣播功能時，操作員可以從廣播麥克風進行廣播。

In OCC, the operation interface equipment of CMFT and OTC includes CMFT console, microphone, speaker and headset. The following describes CMFT operation conceptual mode of OTC.

(A)When PI or SI function is triggered from train, operator can see the information of PI or SI form CMFT console and use microphone and speaker or headset to communicate with train.

(B)When operator use CMFT console to active on-train central monitor function, OCC can use speaker to monitor the voice form on train PI.

(C)When operator use CMFT console to active on-train PA function, operator can use microphone to broadcast voice to the train.

- (6) 列車與 OCC 之語音通訊將會在 OCC 錄音於自動電話系統的錄音設備，錄音設備可以辨別記錄之通訊出處及時間。

The voice communication between on train and OCC will be recorded in OCC by the recording equipment of AT system. The voice content includes source and time. The voice recorder can recognize and record the communication source and time.

整體架構請參照下圖 2-1 列車通訊系統架構圖。

Please refer to the Figure 2-1 for OTC System Structure as below.

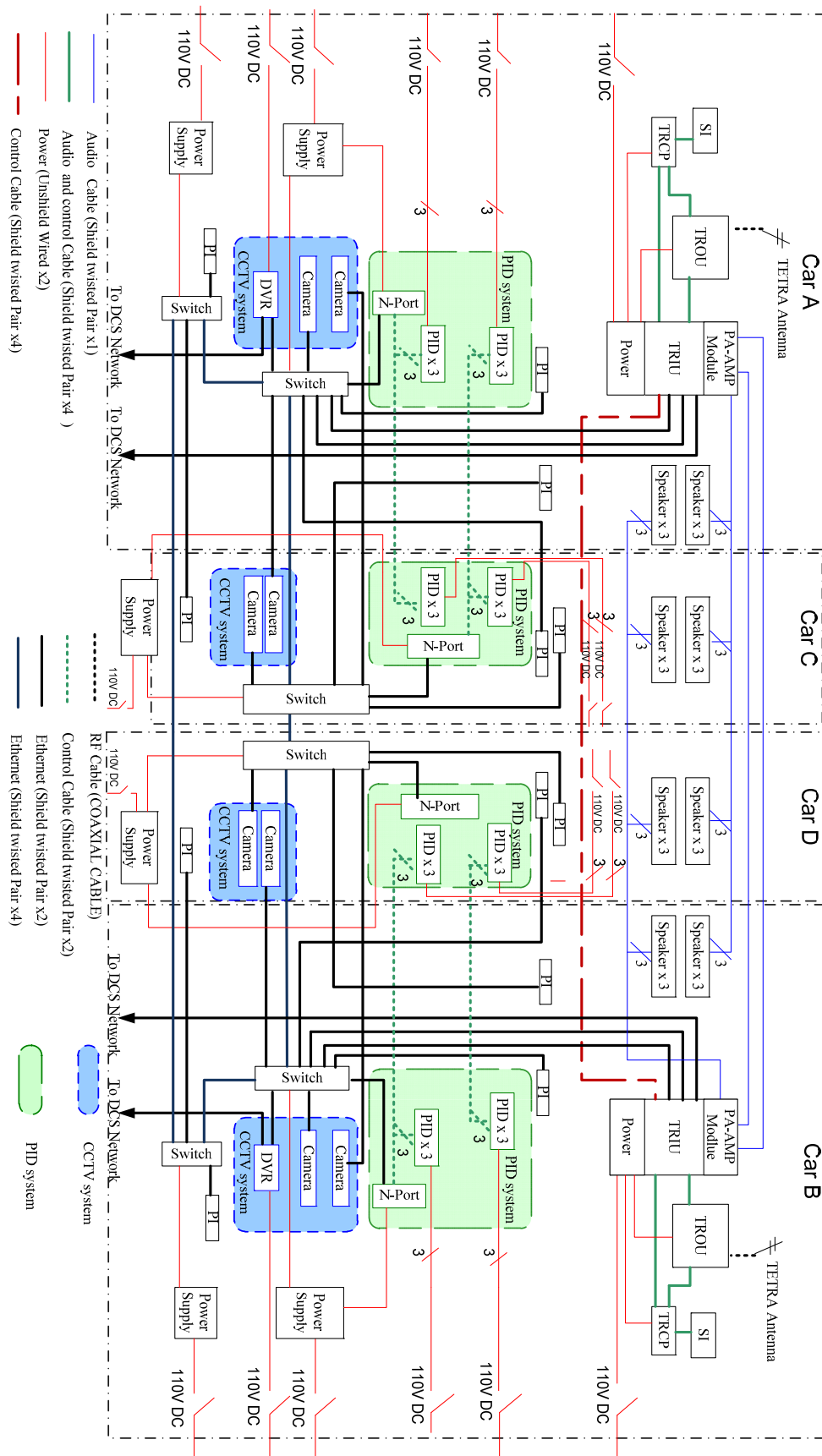


圖 2-1：列車通訊系統架構圖

Figure 2-1 : On Train Communication System Architecture

### 3 系統功能 SYSTEM FUNCTION

本章將對列車通訊系統的系統功能以及系統操作功能做說明。

This section will describe the system function and operation function of the proposed on train communication system.

#### 3.1 OTC 系統說明 SYSTEM DESCRIPTION OF OTC

下表說明列車通訊系統(OTC system)所提供的功能。

The following table summarizes the functions will be provided by On-Train Communication System (OTC system):

表 3-1：列車通訊系統功能列表  
 Table 3-1 : On-Train communication system function list

功能 Functions	通訊功能說明 Communication functions description
旅客資訊顯示器 Passenger Information Display	<ul style="list-style-type: none"> <li>● 列車上，TRIU 基於接收到列車控制器的事件，將自動於旅客資訊顯示器上顯示文字訊息。</li> <li>● TRIU initiates automatic text message displays on the PIDs along the train based on events received from Carborne Controller.</li> <li>● CMFT 操作員將預設的訊息顯示於所選擇的所有列車或任一選擇的列車或車組。</li> <li>● CMFT operator initiates predefined messages which display on PID to all trains, one selected train or group of trains.</li> <li>● CMFT 操作員可將輸入的文字訊息顯示於所選擇的所有列車或任一選擇的列車或車組。</li> <li>● CMFT operator initiates free text messages which display on PID to all trains, one selected train or group of trains.</li> </ul>
廣播 Public Address	<ul style="list-style-type: none"> <li>● 列車上，TRIU 基於接收到列車控制器的事件，將自動廣播相關的列車訊息。</li> <li>● TRIU initiates automatic audio announcement to on-train speakers throughout the train based on events received from Carborne Controller.</li> <li>● CMFT 操作員可以將預錄的訊息廣播至所選擇的所有列車或任一選擇的列車或車組。</li> <li>● CMFT operator initiates predefined audio message to all on-train speakers of all trains, one selected train or group of trains.</li> <li>● CMFT 操作員可以將口播的訊息廣播至所選擇的所有列車或任一選擇的列車或車組。</li> <li>● CMFT operator initiates live announcement to all on-train speakers of all trains, one selected train or group of trains.</li> </ul>

功能 Functions	通訊功能說明 Communication functions description
服務對講機 Service Intercom	<ul style="list-style-type: none"> <li>● 當手動駕駛模式時，提供駕駛員與 CMFT 操作員之間的半雙工的語音通訊。</li> <li>● Provide half-duplex voice communication between the Driver and OCC operator when manual mode driving.</li> <li>● 當手動駕駛模式時，提供駕駛員與旅客之間的半雙工的語音通訊。</li> <li>● Provide half-duplex voice communication between Train Operator and passengers when manual mode driving.</li> <li>● 可藉由列車的喇叭，對列車進行口語廣播。</li> <li>● Live announcement to on-train speakers throughout the train.</li> </ul>
緊急對講機 Passenger (Emergency) Intercom	<ul style="list-style-type: none"> <li>● 提供旅客與 CMFT 操作員之間的雙向的語音通訊。</li> <li>● Provide 2-way voice communication between passengers and CMFT operator in case of emergency.</li> <li>● 提供旅客與駕駛員之間的語音通訊。</li> <li>● Provide communication between passengers and Train Operator in case of emergency.</li> </ul>
故障偵測 Fault diagnostic	<ul style="list-style-type: none"> <li>● 監看 OTC 設備的狀態，並將故障回傳至 OCCCMFT 伺服器。</li> <li>● Monitor the health status of OTC equipment and transmit the failure to OCC CMFT server.</li> </ul>

### 3.1.1 TETRA 無線電控制面板 TETRA RADIO CONTROL PANEL

TETRA 無線電控制面板為提供駕駛員操作列車通訊功能，此控制面板上由一些功能操作按鍵以及配置麥克風喇叭的服務對講機。

TRCP is the operation control panel for driver to operate on board Communication System during the manual operation mode. It is composed of hard buttons and one service intercom unit.

TETRA 無線電控制平台提供以下幾個按鍵

(1) 主控 (2) 車內廣播 (3) 確認 (4) 行控 (5) 旅客對講 (6) 主線 (7) 直通模式 (8) 機廠 (9) 旅客對講主控 (10) 備用 1 (11) 備用 2 (12) 備用 3 (13) 備用 4。

The TRCP provides the following buttons:

(1) Master (2) Local PA (3) Enter (4) OCC (5) PI (6) Main Line (7) DMO (8) Depot (9) PI Master (10) S1 (11) S2 (12) S3 (13) S4.

依功能性質不同，功能按鍵說明如下：

According to different functional properties, function buttons are described below :

表 3-2：TRCP 無線電功能列表  
Table 3-2：TRCP radio function list

分類 Category	名稱 Name	功能描述 Function Description
特殊功能鍵 Special function buttons	主控 Master	作為列車通訊設備(TRIU)之 Master/Slave 切換，當 A Car 之 Master 按下後，A Car 之通訊設備將設定為 Master，B Car 則為 Slave。 To switch Master / Slave mode for the train communication equipment (TRIU), when the Master button is pressed in A Car, A Car's communications equipment will switch to Master mode and B Car will switch to Slave mode.
	旅客對講 主控 PI Master	當列車切換至手動駕駛模式時，駕駛員按下的 PI Master 鍵，OCC 將接獲 PI 主控權切換訊息，列車上的 PI 語音通道切換至 SI 主控。當旅客按下 PI 緊急通話按鈕時，駕駛員可透過 SI 與旅客通話。 When the train switches to manual mode operation, the Train Operator press the PI Master key on the TRCP, OCC will receive the PI mastership switch message, PI voice channels will switch to the SI master. When passenger presses the PI emergency call button, the Train Operator can talk with passenger through the SI.
	車內廣播 Local PA	對列車內進行語音廣播。 The local PA broadcast on the train.
	確認 Enter	進行群組選擇鍵時的確認功能，在選擇了要進行通話的群組後再按下此確認鍵，其通話群組之選擇訊號才會送達 TRIU 進行群組選擇。 To acknowledge the Group selection button, When a Group selection button is selected, the Enter button must be pressed, And then the selected Group will be sent to TRIU and process the group selection. 通話群組按鍵包含：行控、直通模式、主線通話、機廠。 Buttons of group selection contain: OCC, DMO, Main Line, and Depot.
群組選擇鍵 Group selection button	行控 OCC	進行與 OCC 一對一通話。 OCC call
	旅客對講 PI	在手動行駛模式下,接聽來自旅客緊急對講機的通話 Driving in manual mode, the answering of emergency intercom calls from passengers.
	直通模式 DMO	終端設備之間的直接無線通信，不需經過 TETRA 基地台網路。 Direct radio communications between terminal equipment without the TETRA Base Station Network.
	主線通話 Main Line	提供駕駛員加入主線通話群組通話。 Provide driver to join the Main Line talk group.
	機廠 Depot	提供駕駛員加入機廠通話群組通話。 Provide driver to join the Depot talk group.



備用鍵 Spare	備用 1~4 S1~4	備用 1~4 Spare 1~4
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當駕駛員在 TRCP 面板上選擇不同功能按鍵後、TRIU 將會執行相對應的功能需求。在 TRCP 面板上配置有喇叭麥克風以及按下即講按鍵的服務對講機來提供語音通訊功能。此服務對講機的預設模式為無線電操做模式。在列車手動駕駛模式下時只有在主控模式下的 TRCP 面板能提供操作功能。

Once the driver selects the different function modes from TRCP, the TRIU will perform the request. One Speaker Mic. with a non-locking type “press to talk” switch work as the service intercom (SI) is connected to TRCP to provide the audio communication function. By default, this SI is assigned to Radio Mode if there is no other mode operating. Only the TRCP in Master mode can be operated by the driver during the manual driving mode.

列車上所配置的 TETRA 無線電車機為 SEPURA SRG3900、無線電車機主要提供列車通訊系統語音及資料傳輸通道於 TRCP 及行控中心、機廠、其他無線電使用者間通訊。無線電車機經由同軸電纜連接安裝於車頭端上方的無線電專用天線。

SEPURA SRG3900 TROU provides voice and data communication channels for the TRCP to depot, OCC and other TETRA radio subscriber. Radio antenna is connected to the TROU by RF coaxial cable and install on the front of vehicle.

下表為 TETRA 無線電車機所提供的無線電功能：

Operational features of TROU are tabulated in the following:

表 3-3：TROU 無線電功能列表  
Table 3-3：TROU radio function list

Item	Operational Feature	Description
1	選擇通話群組 Assign talk group	<ul style="list-style-type: none"> <li>機廠通話群組 Depot talk group</li> <li>行控中心通話群組 OCC talk group</li> </ul>
2	選擇緊急通話 Set Emergency call priority	<p>通話可以設為一般或是緊急通話優先權</p> <p>Call priority can be set to normal, or Emergency pre-emptive.</p>
3	選擇正常和直通模式的通話方式 Change operational mode between normal voice and direct mode operation	<p>語音通話可以選擇一般群組通話或直通模式</p> <p>Voice call mode can be changed to select direct mode operation or normal voice communication.</p>



Item	Operational Feature	Description
4	提供資料傳輸功能 Provide data communication channel	控制訊號資料介由短訊息傳送 Data message is sent from central control as SDS text message.

駕駛員在手動駕駛模式可以在 TRCP 面板上操作的無線電功能如下：

The driver can operate the following radio functions in the TRCP:

- 與行控中心建立語音通話
- 在手動行駛模式下,接聽來自旅客緊急對講機的通話
- 與機廠控制員建立語音通話
- 與預設的特別無線電通話群組建立通話
- 執行無線電直通模式通話
- 可藉由列車的喇叭，對列車進行口語廣播。
  
- Make radio voice communication with OCC operator
- Driving in manual mode, the answering of emergency intercom calls from passengers.
- Make radio voice communication with Depot controller
- Make radio voice communication with preset special talk group
- Make radio direct mode operation (DMO)
- Live announcement to on-train speakers throughout the train.

TROU 無線電車機、TRCP 無線電控制面板以 TRIU 列車無線電介面單元間的界面說明請參考下列圖 3-1 說明

The interface diagram among Mobile Radio Terminal (TROU), TRCP and TRIU is depicted in Figure 3-1

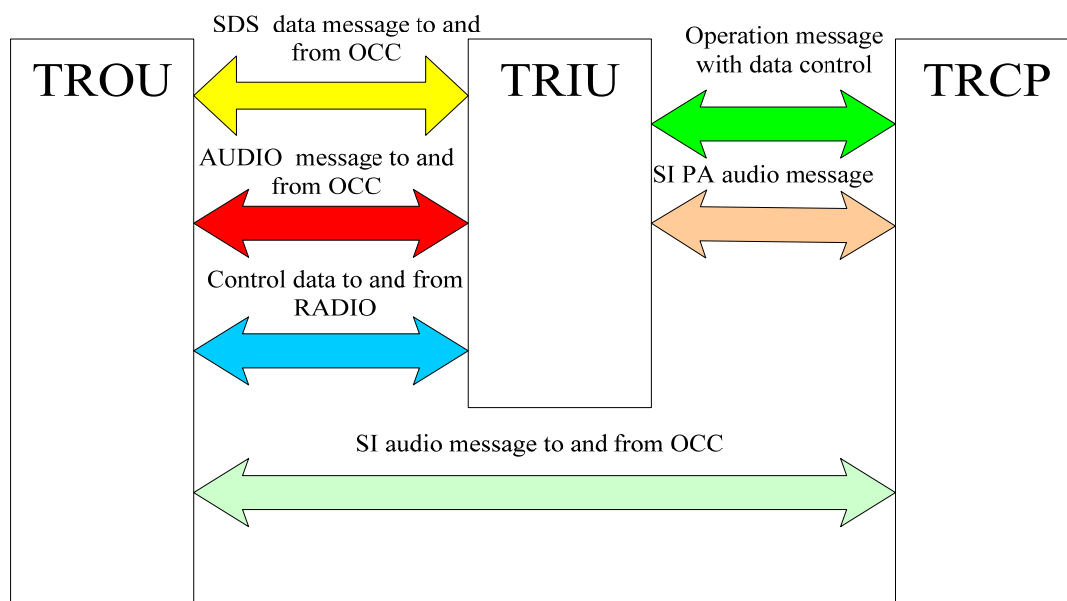


圖 3-1 : TROU、TRCP、TRIU 之間的界面  
Figure 3-1 - Interface among TROU, TRCP and TRIU

### 3.1.2 TETRA 無線電介面單元 TETRA RADIO INTERFACE UNIT

TRIU 是列車上通訊設備與 TETRA 無線設備以及 OTC 設備間的介面控制器，TRIU 通訊介面包含 PI 設備語音通訊、PID 的訊息通訊、喇叭的語音、TROU 的語音和訊息傳送、CC 的訊息通訊和 TRCP 的控制訊息通訊，TRIU 的組成包含電腦主機、廣播放大器、音訊通道控制器還有電源供應器。

TRIU is the interface controller between on train communication equipment and the TETRA radio equipment, and the communication between OTC equipment. TRIU communicate interface including PI voice communication, PID message communication, Speaker audio, TROU voice and message transmission, CC message communication and TRCP control message. TRIU is composed with CPU board, PA-amplifier, Audio switch control and Power supply.

所有 OTC 設備的語音訊號、控制訊號，將藉由 TETRA 無線傳輸網路傳送至 OCC。關於觸發列車 CCTV 的告警訊號如偵煙器和緊急把手，TRIU 將經由乙太網路界面接收到列車控制器傳送來的告警，再經由 TETRA 數位無線電將告警送回 OCC 的 CMFT 伺服器。

All the audio and control information from OTC equipment will be sent to OCC through TETRA Radio network. Regarding On train CCTV trigger alarm like smoke detector and Emergency Pull Handle, TRIU will get the alarm from CC via the Ethernet interface then send the alarm back to OCC CMFT Server as the SDS by TETRA Radio communication network

如圖 3-2 說明 TRIU 的邏輯圖。

Figure 3-2 depicts the logical diagram of TRIU.

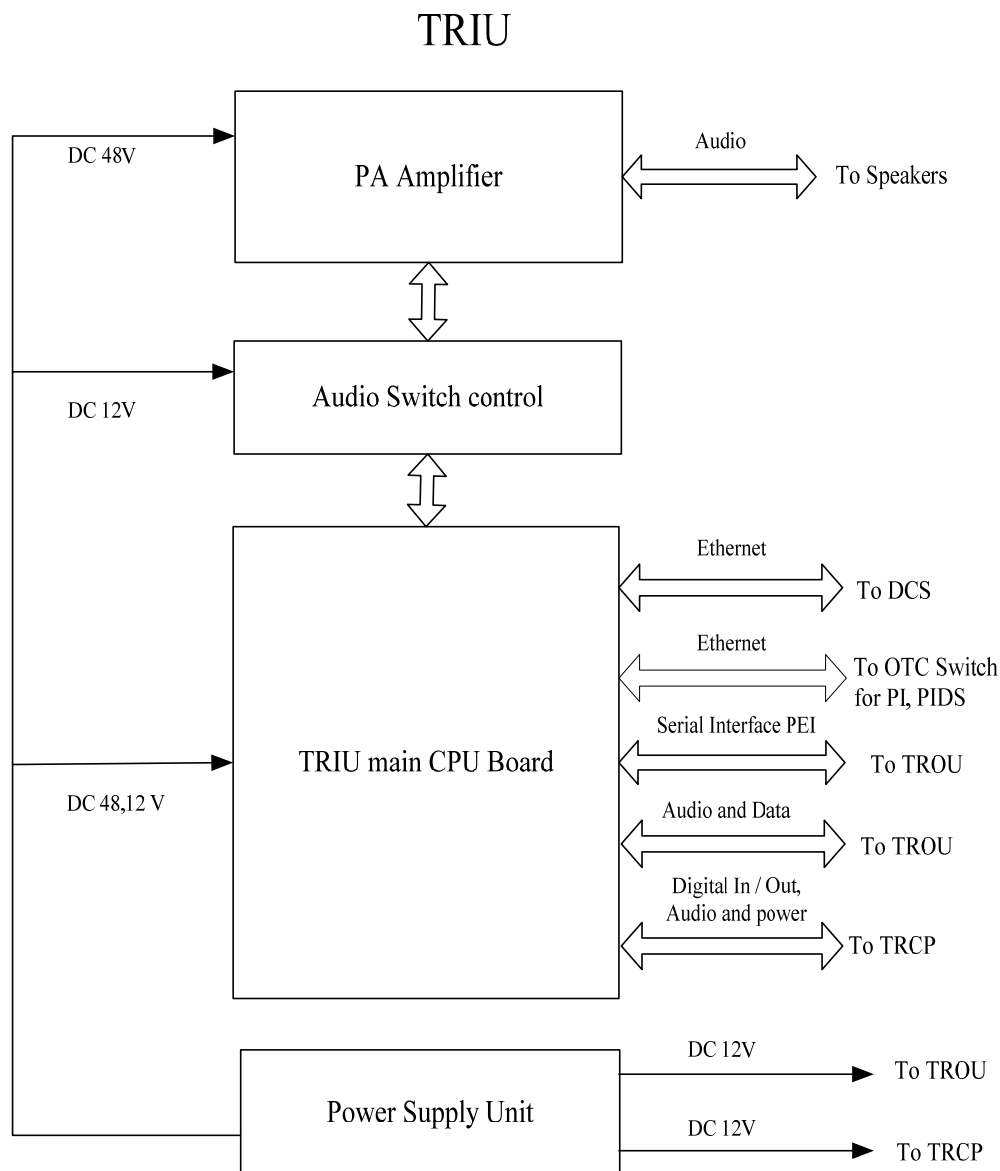


圖 3-2 : TRIU 的邏輯圖  
Figure 3-2 Logical diagram of TRIU

列車電源為 110VDC，藉由 TRIU 的電源供應器調整為 12V 和 48V。電源供應器將電源做適當的整流之後提供給 TRIU。電源供應器將列車的電源與 TRIU 隔離，並提供給 TROU,TRCP 以及 PA Amplifier。

The train power will be 110VDC. The train power will be regulated and transformed to 12V and 48V which are provided by Power Supply Unit of TRIU. The power to TRIU will be regulated by Power Supply Unit. Power Supply Unit will also electrically isolate TRIU and train power. TRIU will provide power to TROU, TRCP and PA Amplifier.

### 3.2 廣播 PUBLIC ADDRESS

列車可藉由車廂的喇叭廣播至旅客，共有 6 個喇叭各安裝於 A-Car, C-Car, D-Car 和 B-Car。TRIUI 提供兩個語音介面，一個經由本身廣播功放放大器驅動列車單邊共 12 隻喇叭，另一個連接至列車尾端 TRIUI 的廣播功放放大器驅動列車單邊共 12 隻喇叭。請參考圖 3-3 和 3-4 廣播的系統訊號流程圖。

Public announcements can be broadcasted to passengers via on train speakers. There are 6 speakers per each A-Car, C-Car, D-Car and B-Car. There are 2 audio interfaces provided by TRIUI. One audio interface will connect to the build in PA power amplifier drives one side of 12 speakers along the train. The other audio interface will connect to the train end TRIUI's PA power amplifier drives the other side 12 speakers of the train. Please refer to Figure 3-3 and 3-4 for the system signal flow diagram of making public address.

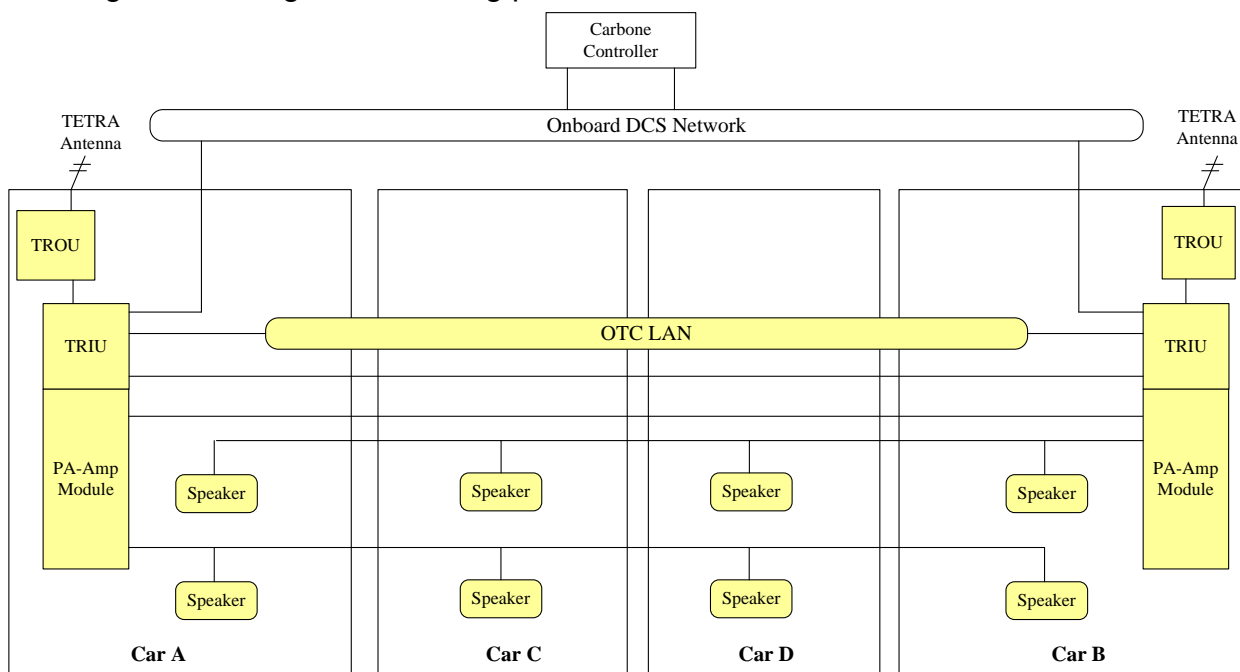


圖 3-3：廣播的系統架構流程圖

Figure 3-3 the system diagram of making public address

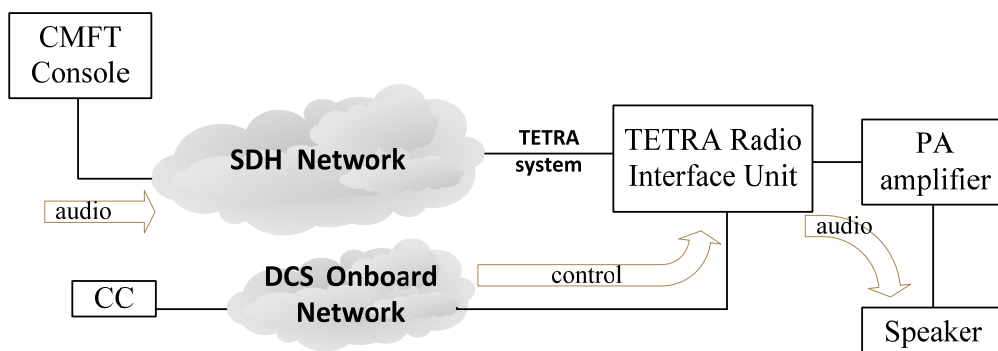


圖 3-4：廣播的系統訊號流程圖

Figure 3-4 the system signal flow diagram of making public address

廣播系統提供四種廣播操作模式，每種操作模式將會有不同的等級，廣播的操作模式將會在以下面由低到高依序列出。

1. 自動語音訊息(列車控制模式)
2. 由 OCC 傳送過來的預錄語音
3. 由 OCC 傳送過來的口語廣播
4. 透過服務對講機傳送過來的口語廣播。

There are four public address operation modes. Each public address operation mode will have different operation priority. The public address operation mode is listed below in order of the lowest priority to the highest priority:

1. Automatic audio message (Train Control Mode);
2. Predefined audio messages from OCC;
3. Live announcement made from OCC;
4. Live announcement made through the Service Intercom.

在列車開關門前，車組的列車控制器將提供一個觸發訊號給 TRIU，在列車關門前，TRIU 將發出告警的聲響，並在 PID 上顯示”列車即將關門”的訊息。告警的聲音將持續直到車門完全關閉或開啟。

Before the door closing or door opening, the CC in the train will provide door-closing/door-opening trigger to TRIU. Before the door closes, the TRIU will play the alert tone audio and display "Please Stand Back From the Door" message in PIDs. The alert tone and message will be played until the door completely closed or opened.

每一個等級的特性如下說明:

The characteristics of Priority modes will be shown below:

- 如果廣播系統存在著較高等級的操作的模式(例:從服務對講機來的廣播)，對於任何新的廣播操作的需求(例:從 OCC 來的預錄訊息)，TRIU 將不會有任何動作。

TRIU will take no action if the priority of existing public address operation mode (e.g. Live announcement made through the Service Intercom) is higher than the new request of public address operation mode (e.g. predefined audio messages from OCC).

- 當新的廣播操作模式的等級高於目前的等級，新的廣播將會立刻取代現有的。  
The new public address operation mode will override the current public address operation mode immediately if the new public address operation mode has higher priority than the current public address operation mode.

- 當新的廣播操作模式與現有的的等級相同，新的廣播將會立刻取代現有的。  
The current public address operation mode will be overridden by the new public address operation mode if they have same priority.

- 在完成任何一個廣播的模式，TRIU 就會將模式切換回列車控制模式。

When any one of public address operation modes is completed, TRIU will set the public address operation mode to Train Control Mode.

- 在預設的情況下，TRIU 會將廣播切換至較低等級的列車控制模式。

By default, the TRIU will switch the public address operation mode to the lowest priority mode which is the Train Control Mode.

### **3.2.1 自動語音訊息(列車控制模式) AUTOMATIC AUDIO MESSAGE (TRAIN CONTROL MODE)**

當 TRIU 透過乙太網路介面收到 CC 的事件驅動，TRIU 就會對全雙節車組進行廣播，這些語音訊號將包含：國語、台語、客家話及英文。在接受到 CC 的訊號後，下列的訊息將廣播一次。

Once the TRIU receives an event trigger from the CC through Ethernet interface, TRIU will broadcast the corresponding audio messages to all on train speakers within the train. The audio messages will be broadcasted in Mandarin, Taiwanese, Hakka and English.

The following messages will be broadcasted:

- 歡迎詞 Welcome message
- 站名 Name of current station
- 列車離開訊息 Leave train message
- 關門警示音 Doors closing alert tone
- 開門警示音 Doors opening alert tone
- 轉乘站訊息 Transfer station

當 TRIU 接收到由 OCC 傳來的自動廣播訊息、或由 OCC 傳來的口語廣播或由服務對講機的口與廣播，由 CC 傳來的預錄廣播將會被立即中斷。

If the TRIU receives public address operation mode of Predefined audio messages from OCC, Live announcement made from OCC or Live announcement made through the Service Intercom, the automatic audio message requested by CC will be interrupted immediately.

由 CC 傳來的預錄廣播的訊息內容存於 TRIU 裡。TRIU 將提供 200MB 儲存容量儲存列車預錄廣播的訊息內容和乘客資訊顯示內容文字，而維修人員將透過 TRIU 的故障偵測埠進行列車預錄廣播的訊息內容和乘客資訊顯示內容更新，詳細更新方式請參考 TC1-6A206 列車通訊 – 系統軟體，TRIU 將控制乘客資訊顯示同步顯示列車預錄廣播的訊息內容。

The predefined audio messages requested by CC are stored in TRIU. TRIU will provide 200MB capacity to store the content of predefined audio and predefined text message of PID. Maintenance staff can update the content of predefined audio and predefined text message of PID via diagnose port of TRIU, please refer to TC1-6A206 OTC – System Software for detail. TRIU will also control PIDs to display the message synchronously as the content of predefined audio.



### 3.2.2 從 OCC 來的預錄廣播訊息 PREDEFINED AUDIO MESSAGES FROM OCC

OCC 的操作員可對所有列車、單一選擇的列車或車組進行預錄廣播。

The OCC operator can broadcast predefined audio messages to all trains, one selected train or group of trains.

由 OCC 傳送預錄廣播的操作流程如下說明：

The operation flow of initiating predefined audio messages from OCC is shown as follow:

1. OCC 的操作員在 CMFT 上選擇所有列車、單一選擇列車或車組進行預錄廣播。然而，如果所選擇的列車正由服務對講機廣播或 OCC 的口語廣播時，CMFT 將不會允許操作員進行預錄廣播。

OCC operator selects all trains, one train or group of trains in the CMFT for broadcasting predefined audio messages. However, if the selected train(s) is making live announcement through the Service Intercom or making live announcement from OCC, CMFT will not allow OCC operator to make predefined audio announcement.

2. CMFT 將 OCC-to-Train 的預錄廣播要求傳送至 CMFT 伺服器。

The CMFT sends the OCC-to-Train predefined audio message request to the CMFT server.

3. CMFT 伺服器將預錄廣播要求透過 TETRA 數位無線通訊網路傳送至所選擇列車的 TRIU。

The CMFT server sends the predefined audio message request to the TRIU of the selected train(s) via TETRA Radio communication network.

4. 在所選擇的列車上的 TRIU，當它接收到 CMFT 伺服器的訊號之後，將會回應一個訊號給 CMFT 伺服器。然後 TRIU 就會將廣播的操作模式由列車控制模式切換至由 OCC 傳來的預錄廣播模式。

The TRIU of selected train(s) will acknowledge to the CMFT server after received the predefined audio message request. The TRIU will switch the public address operation mode to Predefined audio messages from OCC mode

5. CMFT 伺服器將預錄語音訊息傳送到混合器，然後混合器將預錄語音訊息傳送到數位無線交換機經由 TETRA 數位無線網路傳送所選擇的列車的廣播語音功能。

The CMFT server will send the predefined audio message to mixer. The mixer will then sends the predefined audio message to TETRA central server. The predefined audio message will then send to TRIU to the selected train(s) through the TETRA Radio Communication network.

6. 所選擇列車的 TRIU 再將接收預錄訊息的語音訊號，然後透過車廂的喇叭對全車進行廣播。

The TRIU of the selected train(s) received predefined audio messages to analogue audio signal for audio broadcast through on-train speakers.

### 3.2.3 從 OCC 來的口語廣播 LIVE ANNOUNCEMENT MADE FROM OCC

OCC 的操作員可對所有列車、單一選擇的列車或單一選擇的雙節車組進行口語廣播。

The OCC operator can make OCC-to-Train live announcement to all the trains, one train or group of train.

由 OCC 傳送口語廣播的操作流程如下說明：

The operation flow of making live announcement made from OCC is shown as follow:

1. OCC 的操作員在 CMFT 上選擇所有列車、單一選擇列車或車組進行口語廣播。然而，如果所選擇的列車正由服務對講機廣播口語廣播時，CMFT 將不會允許操作員進行口語廣播。

OCC operator selects all trains, one train or group of train in the CMFT for making live announcement. If the selected train(s) is making live announcement through the Service Intercom, CMFT will not allow OCC operator to make live audio announcement.

2. CMFT 將 OCC-to-Train 的口語廣播要求傳送至 CMFT 伺服器。

The CMFT sends the OCC-to-Train live announcement request to the CMFT Server.

3. CMFT 伺服器將預錄廣播要求透過 TETRA 無線通訊網路傳送至所選擇列車的 TRIU。

The CMFT Server sends the live announcement request to the TRIU of selected train(s) via TETRA Radio communication network.

4. 在所選擇的列車上的 TRIU，當它接收到 CMFT 伺服器的訊號之後，將會回應一個訊號給 CMFT 伺服器。然後 TRIU 就會將廣播的操作模式由列車控制模式切換至由 OCC 傳來的口語廣播模式。

The TRIU of selected train(s) will acknowledge to the CMFT Server after received the live announcement request. The TRIU will switch the public address operation mode to live announcement from OCC mode.

5. OCC 的操作員可使用麥克風進行口語廣播，口語廣播的訊息將傳送至混合器。

OCC operator uses the microphone make live announcement. The live announcement will send to the Mixer Unit.

6. CMFT 伺服器將預錄語音訊息傳送到混合器，然後混合器將預錄語音訊息傳送到數位無線交換機經由 TETRA 數位無線網路傳送所選擇的列車的廣播語音功能。

The CMFT Server will send the predefined audio message to mixer. The mixer will then sends the predefined audio message to TETRA central server. The predefined audio message will then send to TRIU to the selected train(s) through the TETRA Radio Communication network.

7. 所選擇列車的 TRIU 再將口語廣播訊息的語音訊號，然後透過車廂的喇叭對全車進行廣播。

The TRIU of the selected train(s) received live announcement to analogue audio signal for broadcasting through on-train speakers.

### **3.2.4 由服務對講機的口語廣播 LIVE ANNOUNCEMENT MADE THROUGH THE SERVICE INTERCOM**

由服務對講機所進行廣播的操作及功能說明，請參考 3.4.2 章節的說明。

Please refer to the section 3.4.2 for detail function and operation of making live announcement through the Service Intercom.

### **3.2.5 廣播語音聲壓計算 PA SOUND PRESSURE LEVEL**

在 OTC 的設計裡，Acoustic 喇叭的音量將超過列車行駛時的噪音至少 6dB，以列車行駛 70 公里/小時時車內最大噪音限值 83dBA 為條件，音壓的計算方式如下：

In the OTC design, the speaker's pressure will exceed the interior car noise by minimum 6dB. **For 83dBA as train interior noise limitation when train is at 70km/h, the calculation for the speaker power-tapping-acoustic pressure has shown as follow**

列車上的音壓(SPL)的計算公式如下：

Sound pressure Level (SPL) on the train is calculated using the following equation:

$$\text{SPL} = \text{SPL1} + 10\log P - 20\log R1 + \text{Adjusted value}$$

$$\geq \text{background noise pressure Level} + 6\text{dB}$$

SPL1: 1W 喇叭的音壓 Sound Pressure Level of the speaker in 1W

P: 喇叭的輸出功率 Output power of the speaker

R1: 接收者和喇叭間的距離 Distance between the receiver (passenger) and the speaker

表 3-4：各喇叭與音壓量測點的相對位置座標

Table 3-4 : the relative coordinates of speakers and each sound pressure level measure points

Location		x coordinate(mm)	y coordinate(mm)	Height(mm)
Speaker (on Car A、B)	SP1	0	1598	1910
	SP2	3215	0	1910
	SP3	5340	1598	1910
	SP4	8440	0	1910
	SP5	10565	1598	1910
	SP6	13113	329	1743
Speaker (on Car C、D)	SP7	0	1128	1743
	SP8	2548	0	1910
	SP9	4673	1598	1910
	SP10	7773	0	1910
	SP11	9898	1598	1910
	SP12	12446	329	1743

Location		x coordinate(mm)	y coordinate(mm)	Height(mm)
Measure Point (on Car A、B)	A	803.75	0	1500
	B	1607.5	799	1500
	C	2440	1598	1500
	D	4277.5	799	1500
	E	6115	0	1500
	F	6890	799	1500
	G	7665	1598	1500
	H	9502.5	799	1500
	I	11340	0	1500
	J	11839	963.5	1500
	K	12476	1598	1500
	Q	14736.5	728.5	1500
Measure Point (on Car C、D)	L	637	0	1500
	M	1274	564	1500
	N	1773	1598	1500
	O	3610.5	799	1500
	P	5448	0	1500

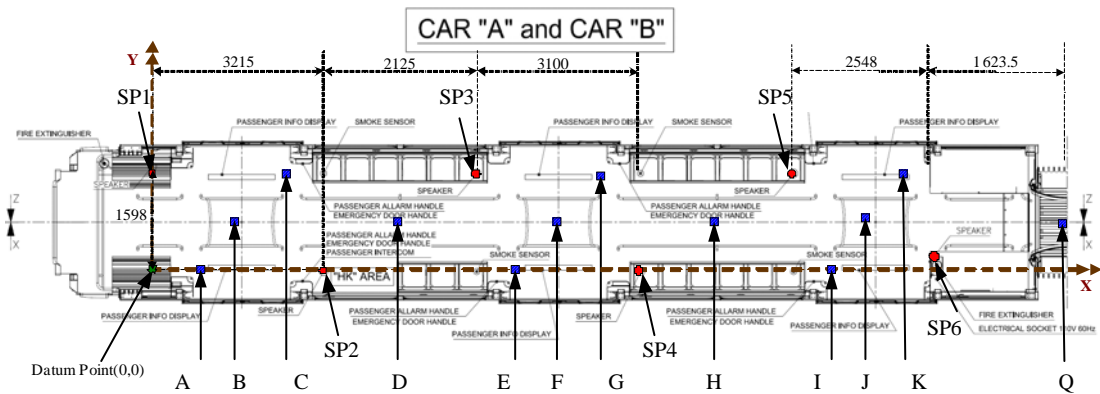


圖 3-5 “A”車廂和“B”車廂上喇叭位置和計算的 SPL 點 A、B、C、...、K、Q  
Figure 3-5 the positions of the Speakers and the considered SPL positions Position A、B、C、...、K、Q on the Train of car “A” and car “B”

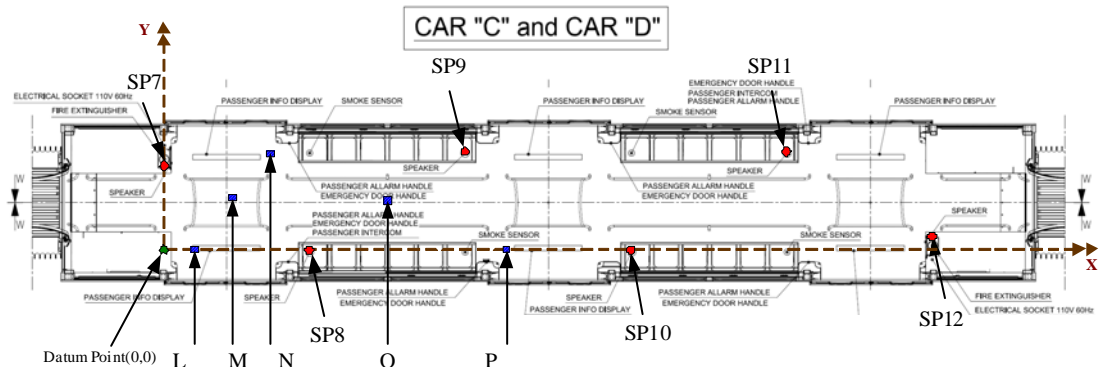


圖 3-6 “C”車廂和“D”車廂上喇叭位置和計算的 SPL 點 L、M、N、O、P  
Figure 3-6 the positions of the Speakers and the considered SPL positions Position L、M、N、O、P on the Train of car “C” and car “D”

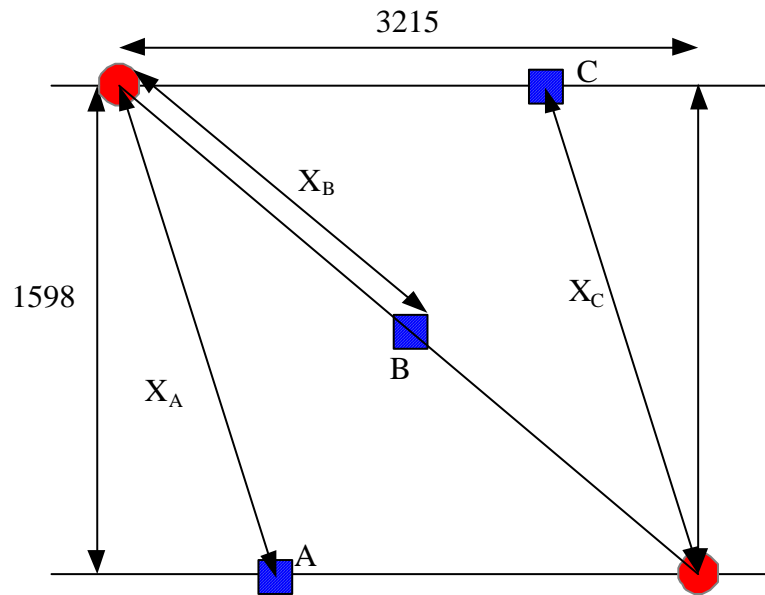


圖 3-7 “A”車廂和“B”車廂上 A、B、C 的位置

Figure 3-7 the position A、B、C on the car “A” and car “B”

A、B 車廂內有 6 具喇叭，其中五具距離地板高度 1820mm，另外一具則離地 1743mm。C、D 車廂內同樣有 6 具喇叭，其中四具距離地板高度 1820mm，另外兩具則離地 1743mm。人站立於位置 A、C 皆只受一個喇叭影響。人站立於位置 B 是喇叭中間所以加 3dB。位置 C、E、G、I、N and P 皆為相同情形。考慮喇叭的輸出功率為 2W，位置 A、B 和 C 的 SPL 計算如下：

On CarA and CarB, there are six speakers. Which of the five speakers are at a height of 1820mm and one is 1743mm above the ground. There are also six speakers on CarC and CarD. But which of the four speakers are at a height of 1820mm and two are 1743mm above the ground. One speaker will affect the person standing in position A and C. Position B is the standing position of a person who stands in the middle of the speakers so 3db will be added. Position C、E、G、I、N and P are all the same case. Assume that the power output of the speaker is 2W, the SPL of the Position A、B and C are calculated as the followings:

$$\begin{aligned} \text{SPL}(A) &= 92 + 10\log 2 - 20\log \left[ \sqrt{X_A^2 + h^2} \right] \\ &= 92 + 3.01 - 20\log \sqrt{1.789^2 + (1.91 - 1.5)^2} = 89.73 \text{ dBA} > 89\text{dBA} \end{aligned}$$

$$\begin{aligned} \text{SPL}(B) &= 92 + 10\log 2 - 20\log \left[ \sqrt{X_B^2 + h^2} \right] + 3 \\ &= 92 + 3.01 - 20\log \sqrt{1.795^2 + (1.91 - 1.5)^2} + 3 = 92.71 \text{ dBA} > 89\text{dBA} \end{aligned}$$



$$\begin{aligned} \text{SPL}(C) &= \text{SPL}(E) = \text{SPL}(G) = \text{SPL}(I) = \text{SPL}(N) = \text{SPL}(P) \\ &= 92 + 10 \log 2 - 20 \log \left[ \sqrt{X_C^2 + h^2} \right] \\ &= 92 + 3.01 - 20 \log \sqrt{1.776^2 + (1.91 - 1.5)^2} = 89.80 \text{dBA} > 89 \text{dBA} \end{aligned}$$

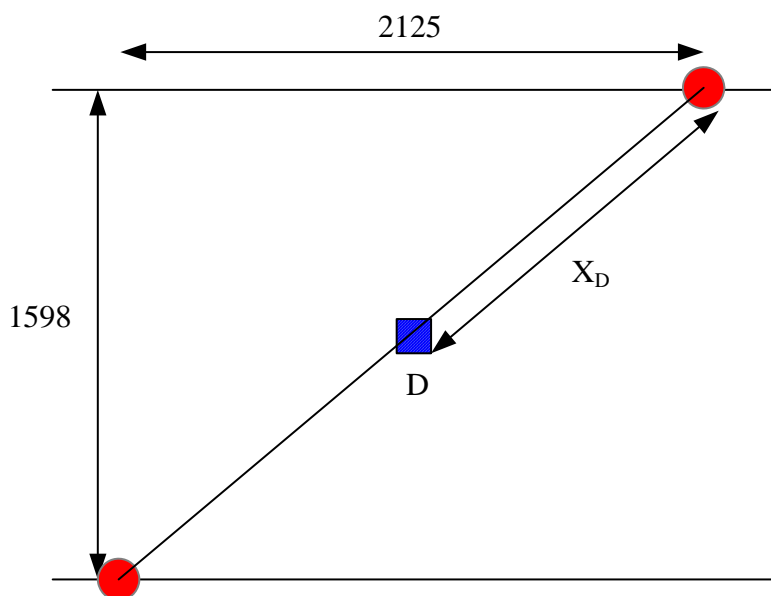


圖 3-8 “A”車廂和“B”車廂上 D 的位置  
Figure 3-8 the position D on the car “A” and car “B”

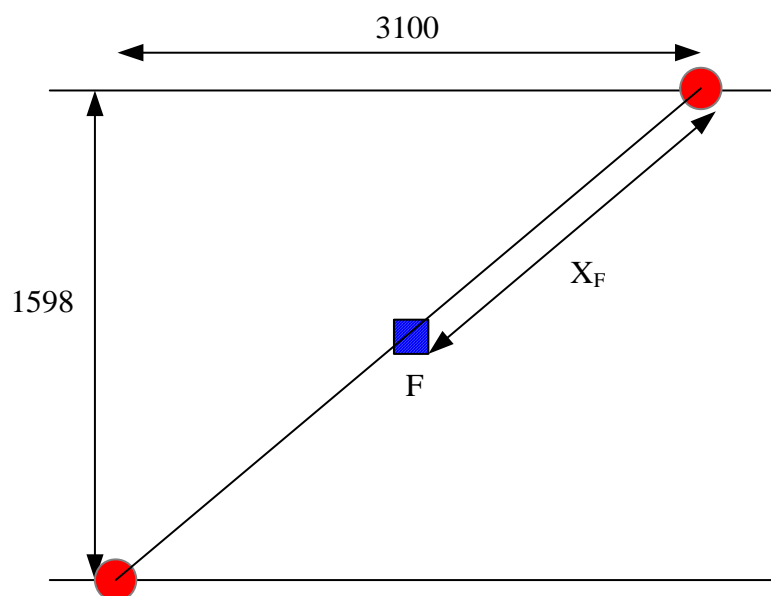


圖 3-9 “A”車廂和“B”車廂上 F 的位置  
Figure 3-9 the position F on the car “A” and car “B”

站立於位置 D 及位置 F 的人會受到兩個喇叭的影響效果，所以會增加 3dB。其中位置 D、H 與 O 皆為相同情形。

Two speakers will affect the person standing in position D and position F. An adjusted value 3db, therefore, will be added. Position D、H and O are all the same case.

$$\begin{aligned}
 \text{SPL(D)} &= \text{SPL(H)} = \text{SPL(O)} \\
 &= 92 + 10\log 2 - 20\log \left[ \sqrt{X_D^2 + h^2} \right] + 3 \\
 &= 92 + 3.01 - 20\log \sqrt{1.329^2 + (1.91 - 1.5)^2} + 3 = 95.14 \text{ dBA} > 89\text{dBA} \\
 \text{SPL(F)} \\
 &= 92 + 10\log 2 - 20\log \left[ \sqrt{X_F^2 + h^2} \right] + 3 \\
 &= 92 + 3.01 - 20\log \sqrt{1.744^2 + (1.91 - 1.5)^2} + 3 = 92.95\text{dBA} > 89\text{dBA}
 \end{aligned}$$

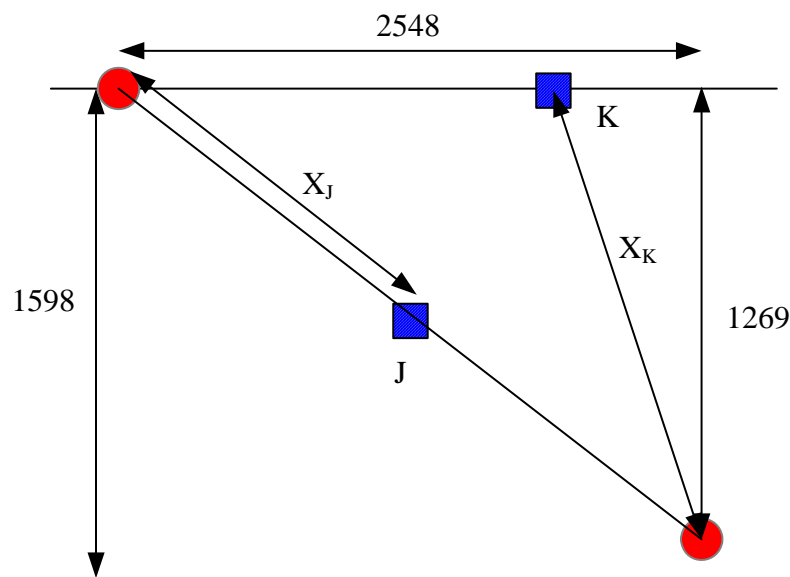


圖 3-10 “A”車廂和“B”車廂上 J、K 的位置

Figure 3-10 the position J and K on the car “A” and car “B”

站立於位置 J 的人會受到兩個喇叭的影響效果，所以會增加 3dB。此外，人站立於位置 K 只受一個喇叭影響。

Two speakers will affect the person standing in position J. An adjusted value 3db, therefore, will be added. Moreover, one speaker will affect the person standing in position K.

$$\begin{aligned}
 \text{SPL(J)} &= 92 + 10\log 2 - 20\log \left[ \sqrt{X_J^2 + h^2} \right] + 3 \\
 &= 92 + 3.01 - 20\log \sqrt{1.423^2 + (1.91 - 1.5)^2} + 3 = 94.60 \text{ dBA} > 89\text{dBA}
 \end{aligned}$$

$$\begin{aligned} \text{SPL(K)} &= 92 + 10\log 2 - 20\log \left[ \sqrt{X_K^2 + h^2} \right] \\ &= 92 + 3.01 - 20\log \sqrt{1.420^2 + (1.743 - 1.5)^2} = 91.84\text{dBA} > 89\text{dBA} \end{aligned}$$

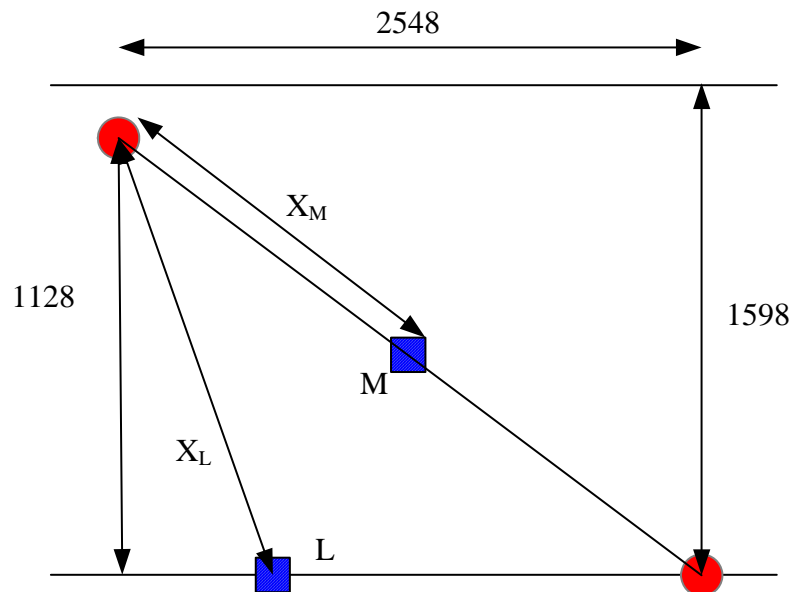


圖 3-11 “A”車廂和“B”車廂間 Q 的位置

Figure 3-11 the position Q between the car “A” and car “B”

站立於位置 M 的人會受到兩個喇叭的影響效果，所以會增加 3dB。此外，人站立於位置 L 只受一個喇叭影響。

Two speakers will affect the person standing in position M. An adjusted value 3db, therefore, will be added. Moreover, one speaker will affect the person standing in position L.

$$\begin{aligned} \text{SPL(M)} &= 92 + 10\log 2 - 20\log \left[ \sqrt{X_M^2 + h^2} \right] + 3 \\ &= 92 + 3.01 - 20\log \sqrt{1.393^2 + (1.91 - 1.5)^2} + 3 = 94.77 \text{ dBA} > 89\text{dBA} \\ \text{SPL(L)} &= 92 + 10\log 2 - 20\log \left[ \sqrt{X_L^2 + h^2} \right] \\ &= 92 + 3.01 - 20\log \sqrt{1.295^2 + (1.743 - 1.5)^2} = 92.61\text{dBA} > 89\text{dBA} \end{aligned}$$

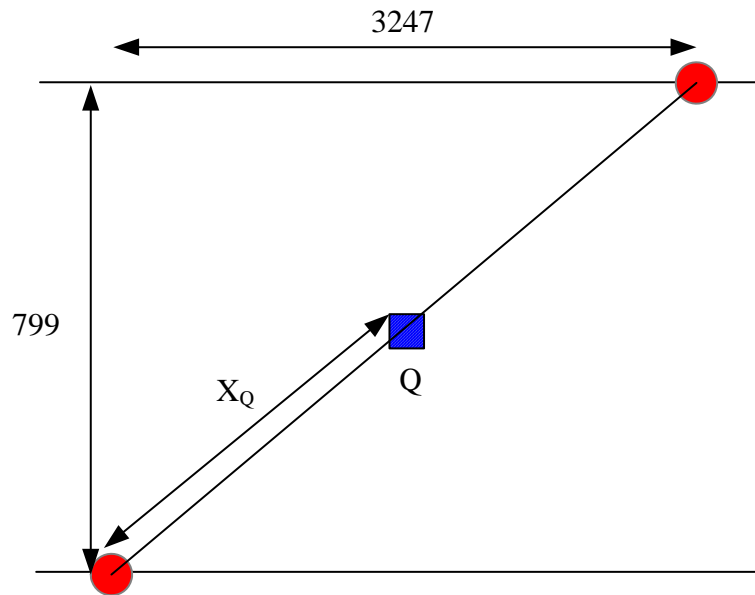


圖 3-12 “A”車廂和“C”車廂間 Q 的位置

Figure 3-12 the position Q between the car “A” and car “C”

站立於位置 Q 的人會受到兩個喇叭的影響效果，所以會增加 3dB。

Two speakers will affect the person standing in position D. An adjusted value 3db, therefore, will be added.

$$\begin{aligned} \text{SPL}(Q) &= 92 + 10\log 2 - 20\log \left[ \sqrt{X_Q^2 + h^2} \right] + 3 \\ &= 92 + 3.01 - 20\log \sqrt{1.672^2 + (1.743 - 1.5)^2} + 3 = 93.45 \text{ dBA} > 89\text{dBA} \end{aligned}$$

在音壓大於環境噪音 6dB 的條件下，音壓與環境的噪音值如下：

As the audio level should have 6dB above the ambient noise, the respective ambient noise level is calculated in the following circumstances.

表 3-5：各位置的音壓與環境的噪音值列表

Table 3-5 : the respective ambient noise level of each position list

Location on train	Estimated SPL Value (dBA)	Ambient Noise (SPL – 6) (dBA)	Horizontal Distance to the nearest speaker (m)
SPL(A)	89.73	83.73	1.789(A to SP1)
SPL(B)	92.71	86.71	1.795 (B to SP1、SP2)
SPL(C)	89.80	83.80	1.776 (C to SP2)
SPL(E)	89.80	83.80	1.776 (E to SP3)
SPL(G)	89.80	83.80	1.776 (G to SP4)
SPL(I)	89.80	83.80	1.776 (I to SP5)
SPL(N)	89.80	83.80	1.776 (N to SP8)
SPL(P)	89.80	83.80	1.776 (P to SP9)
SPL(D)	95.14	89.14	1.329(D to SP2、SP3)
SPL(H)	95.14	89.14	1.329 (H to SP4、SP5)
SPL(O)	95.14	89.14	1.329 (O to SP8、SP9)
SPL(F)	92.95	86.95	1.744 (F to SP3、SP4)
SPL(J)	94.60	88.60	1.423 (J to SP5、SP6)
SPL(K)	91.84	85.84	1.420(K to SP6)
SPL(L)	92.61	86.61	1.295(L to SP7)
SPL(M)	94.77	88.77	1.393 (M to SP7、SP8)
SPL(Q)	93.45	87.45	1.672(Q to SP6、SP7)

上述的結果中，在最差的環境中 case A 允許噪音值為 83.73dBA(也就 SPL 89.73dBA -6dBA)，在最大環境噪音 83dBA 的要求下，旅客所能聽到的 SPL 為 89dBA。

As a result, the maximum ambient noise under the worst circumstance in the case A is allowed to be 83.73dBA (That is, the SPL 89.73dBA – 6dB). The maximum ambient noise level 83dBA requires the audio SPL to be 89dBA (83 + 6dBA) SPL at the passenger's hearing position.

表 3-6：各位置的最低音壓需求高度

Table 3-6：the height of the least SPL demand(89dBA) at each position

Location on train	The height (m) of SPL least demand (89dBA)
SPL(A)	1.021
SPL(B)	0.000
SPL(C)	0.995
SPL(E)	0.995
SPL(G)	0.995
SPL(I)	0.995
SPL(N)	0.995
SPL(P)	0.995
SPL(D)	0.000
SPL(H)	0.000
SPL(O)	0.000
SPL(F)	0.000
SPL(J)	0.000
SPL(K)	0.338
SPL(L)	0.222
SPL(M)	0.000
SPL(Q)	0.000

各量測點之音壓設計考量 **worse case** 條件，旅客站立高度位置不同音壓會稍有變化。但由上表各位置的最低音壓需求高度，可得知在最差的環境中的需求高度為 1.021m。因此各點在最大環境噪音情況下，皆滿足最低音壓強度(89dBA)之需求。

In the OTCS design, the Acoustic speakers pressure should be exceed 89dBA. And there's a little variance vary with the height of passengers. From table3-6, we know the least height demand at 89dBA is 1.021m. Therefore, the maximum ambient noise, are to meet the lowest SPL (89dBA) demand.



```
graph LR; CMFT[CMFT Console] --- SDH((SDH Network)); SDH <-->|audio| TRIU[TETRA Radio Interface Unit]; SDH --- TETRA[TETRA system]; TETRA --- TRIU; TRIU --- Switch[Switch]; Switch --- IP[IP Cameras]; Switch --- PIs[PIs]; Alarms[Alarms] --- CC[CC]; CC --- DCS((DCS onboard Network)); DCS -- alarm --> TRIU;
```

旅客緊急對講機提供如下三個功能：

There are three functions that Passenger (Emergency) Intercom will provide:

- 與 OCC 的雙向語音通訊 The Full duplex voice communication with OCC.
- 與 SI 半雙工的語音通訊 Half duplex communication with SI.
- 由 OCC 中央監聽 OCC central monitoring.

TRIU 可持續監視 PI 的狀況，當有一座 PI 故障，TRIU 將會監測到 PI 的故障訊息，這個訊息會週期性的傳送，同時，TRIU 會將這個 PI 故障的狀態透過無線網路傳送給 CMFT 伺服器以供紀錄，若 PI 回復正常，TRIU 會偵測到 PI 恢復正常並回傳 9 給 CMFT 伺服器。

TRIU will monitor the health status of PIs within the train continuously. If one of the PIs is failed, TRIU will detect the corresponding failure status of PIs. Simultaneously, TRIU will send the PI failure status to CMFT Server through TETRA Radio communication network for recording. If PI is back to normal condition, TRIU will detect the normal status of PIs and send the normal status back to CMFT server.

### 3.3.1 與 OCC 全雙工的語音通訊 FULL DUPLEX VOICE COMMUNICATION WITH OCC.

在緊急的時候，旅客需要即時與 OCC 的操作員進行全雙工的語音通訊，所以每一列車安裝有 12 具旅客緊急對講器(PI)，車廂 A 車廂 C、車廂 D 和車廂 B 各安裝 3 具 PI，PI 將安裝靠近門邊。安裝在車廂 A 和車廂 B 的三具 PI 其中有一具 PI 將安裝在輪椅區，每一具 PI 都是使用 POE(Power Over Ethernet)方式與車上交換器相

連並透過乙太網路介面 連接至 TRIU，請參考圖 3-13 旅客緊急對講機系統的資料流程圖。

In case of emergency, passengers are required to have real time full duplex voice communication with OCC Operator. 12 Passenger (Emergency) Intercoms (PI) will be located in each train. Each car will mount 3 PIs accordingly. The PIs will be installed next to the doors. In Car A and Car B, one of the 3 PIs will be installed at the wheelchair area. Each of the PIs in a train are individually connected to Switch via POE (Power Over Ethernet) then interface with TRIU. Please refer to figure 3-13 for system data flow diagram of Passenger (Emergency) Intercom.

PI 的全雙工語音通訊的操作流程和功能如下說明：

The functions and operation flow of the full duplex PI voice communication with OCC are shown as follow:

1. 當旅客按下 PI，**2 秒內震鈴聲會響起，且按鍵燈會閃爍**。此時所有的廣播包括 OCC 或列車控制下的廣播都會立刻被中斷，且所有語音廣播要求包括 OCC 的口語廣播、預錄廣播也都會被禁止。

When the Passenger presses the PI in the train then the ring tone will be played within 2 seconds and the button lamp is blinking. All currently broadcasting messages wherever initiated by OCC will be interrupted immediately. The function of live announcement from OCC, predefined audio messages from OCC, OCC central monitoring and predefined audio messages will be prohibited.

2. 此時，TRIU 將 PI 的呼叫要求透過 TETRA Radio SDS 傳送至 CMFT 伺服器，PI 的呼叫要求將會通知 CMFT 伺服器列車上有 PI 提出呼叫要求，同時，CMFT server 會通知 OCC 影像控制伺服器該列車 IP 位置，而 VCS 將通知螢幕控制器把該列車 8 台 IP 網路攝影機影像回傳 OCC 回傳。攝影機的影像畫面會顯示在 OCC 的電視牆上的第 13 和 14 個螢幕，每一個銀幕顯示以四分割的方式顯示列車的 2 節車廂的 4 個攝影機的影像畫面，CMFT 伺服器會記錄下 PI 的呼叫要求並帶著車輛 ID 及 PI 號碼。

The TRIU of train sends the PI call request to the CMFT Server via SDS of the TETRA Radio wireless communication network. The PI call request will notify the CMFT Server that there is a PI call requesting from the train. Simultaneously, CMFT server will notify on OCC Video Control server with the IP address of the train which has just made PI call request. Video Control server will control monitor controller to get the video streaming of 8 IP cameras back to OCC. IP camera videos will be displayed in monitor 13 and monitor 14 of video wall in OCC. Each of them will display 4 IP cameras videos in quad screen pattern of each 2 car of the incident train. CMFT Server will record the PI call request with Vehicle ID and PI number.

3. 在所有 CMFT 上將會產生震鈴以提醒 OCC 的操作員有列車的車組提出 PI 的呼叫要求。

All CMFT will play the ring tone in the audio panel to alert OCC operator that there is PI call request from married pair of the train.

4. 提出呼叫的 PI 的資訊包括車輛 ID 及 PI 號碼將會顯示在 CMFT 上，然後操作員可經由 CMFT 選擇回答該通話要求來起始 PI 通話。

The incoming PI call information including Vehicle ID and PI number will display in all CMFT. The operator answers the call by CMFT answer call function initiated the PI call.

5. 此時，CMFT 和被按下的 PI 間的全雙工語音通訊就會建立起，且 PI 的紅色按鍵燈會恆亮。

The full duplex audio communication channel between the CMFT and the pressed PI will be established and the Red illuminated button of the pressed PI will steady on.

6. 再同一列車組，若超過 1 具 PI 被按下，TRIUI 就會再通知 CMFT 伺服器有 PI 的呼叫要求，已通話的 CMFT 操作員會顯示列車號碼及新的 PI 的號碼，但 OCC 操作員可以透過多方通話的方式與被按下 PI 的列車進行通話，**上限為 2 具 PI 同時與同一 OCC 操作員混音通話**。當另外的車的 PI 被按下，OCC 會將這個呼叫當作另一新的呼叫，並在 CMFT 上顯示列車的 ID 及 PI 的號碼。

In case there are more than one PIs that are pressed from the same train, the TRIUI will notify the CMFT Server by sending the PI call request again. The connected CMFT operator will display the Vehicle ID and PI number of the new pressed PI. The audio panel of CMFT will make conference conversation with pressed PIs, maximum of two PI will be mixed into same voice channel to communicate with OCC operator. In case there are more than one PIs that are pressed from another train, the OCC will handle this PI call requests as new call request. The audio panel of CMFT which is not being occupied will display the Vehicle ID and PI number of that train.

7. 當 OCC 操作員的 CMFT 都在使用中，所有新進來的 PI 的呼叫要求將會被暫存住並顯示在 CMFT 上，被按下的 PI 的按鍵燈將閃爍。暫存的 PI 的呼叫是沒有上限的。

If all of the CMFT are being used by OCC operator, all the new incoming PI calls request will queue up. All CMFT will also display the Vehicle IDs and PI numbers in the queue. The illuminated button of the PI which is in the queue will keep flashing. There is no upper limit in the call waiting queue.

8. 當 OCC 的操作員掛掉話筒結束與 PI 間的通話，CMFT 伺服器就會通知被按下的 PI 的 TRIUI 結束通訊的頻道和通知 OCC 影像控制伺服器結束該列車影像監看，此時，該列車的所有被按下的 PI 將會自動的結束通訊，PI 上的按鍵燈將會熄滅。只有 OCC 的操作員可結束 PI 的通訊。

To terminate the PI conversation, the OCC operator will press the end call function. CMFT Server will be notified to terminate the PI audio communication channel by sending the PI call terminate request to the TRIUI of the pressed PI and CMFT server will also request OCC Video Control Server stop monitoring the train. The audio communication channel will be terminated and the all pressed PIs of that train will be turned off automatically. The illuminated button of the pressed PIs will be steady off. The PI conversation can only be terminated by OCC operator.

9. 當 OCC 的操作員結束列車上所有的 PI 的對話，列車廣播將自動恢復正常。

When OCC Operator terminates all PI conversation on train, the on train audio broadcast function will be back to normal.

### 3.3.2 與 SI 半雙工的語音通訊 HALF DUPLEX COMMUNICATION WITH SI

當列車切換至手動駕駛模式時，駕駛員可使用 SI 接聽來自 PI 的旅客通話。

When the train switches to manual mode operation, the Train Operator can use the SI answering passenger from the PI call.

與 SI 半雙工的語音通訊的操作流程和功能如下說明：

The functions and operation flow of the half duplex PI voice communication with SI are shown as follow:

1. 當列車切換至手動駕駛模式時，駕駛員按下的 PI Master 鍵，OCC 將接獲 PI 主控權切換訊息，列車上的 PI 語音通道切換至 SI 主控，PI Master 鍵燈**恆亮**。

When the train switches to manual mode operation, the Train Operator press the PI Master key on the TRCP, OCC will receive the PI mastership switch message, PI voice channels will switch to the SI master, PI Master key lights **On**.

2. 當旅客按下 PI 緊急通話按鈕時，TRCP 上的 PI 鍵燈閃爍，SI 發出震鈴聲，此時駕駛員按下 PI 鍵即可接聽，透過 SI 與旅客通話。相關操作流程如附件十。

When passenger press the PI emergency call button, the PI key light flashing and SI ringtone on the TRCP, the Train Operator presses the PI button to answer calls through the SI . Related operational processes please see appendix 10.

### 3.3.3 OCC 的中央監聽 OCC CENTRAL MONITORING

OCC 的操作員可使用 CMFT 的監聽喇叭，經由 PI 監聽特定的列車上的旅客的動態。

To monitor the passenger activities in the specific train, the OCC operator can use the monitor speaker of CMFT to listen the specific train situation through the all the PI(s) of the train.

OCC 的中央監聽的操作和功能如下說明：

The functions and operations of the OCC central monitoring are shown as follow:

1. OCC 的操作員於 CMFT 操作畫面啟動中央監聽功能，並輸入列車 ID，若該列車的 SI 已與 OCC 進行通訊，CMFT 就不會允許監聽這列車。

OCC operator starts the OCC central monitoring function on CMFT operation screen and enters the Vehicle ID. If the selected train is making Passenger (emergency) intercom or service intercom voice communication with OCC, CMFT will not allow OCC operator to monitor that train.

2. CMFT 伺服器透過 TETRA 數位無線電通訊網路，通知並送出中央監聽的要求至所選擇的列車的 TRIU。

CMFT Server will be notified and send the central monitoring request to the TRIU of selected train via TETRA digital radio communication.

3. 所選擇的列車的 TRIU 將透過 TETRA 數位無線通訊網路回應要求給 CMFT 伺服器，所選擇的 PI 將切換至收集背景聲音的功能，上限為 2 具 PI 同時監聽。

The TRIU of selected train will send the acknowledgement to CMFT Server via TETRA digital radio communication network. The selected PI will switch to the function of collecting background sound, maximum of two PI same time monitored.

4. CMFT 伺服器會送出所選擇列車 TRIU 的列車 ID 位置給 TETRA 無線電系統且要求建立單工的語音頻道，此時 OCC 的操作員將可聽到所選擇列車的環境的聲音。在 OCC 監聽的期間裡，可持續 ATC 自動預錄廣播、SI 的口語廣播。

The CMFT Server will then send the Vehicle ID of the TRIU of the selected train to TETRA radio system and the half duplex audio channel will be established. The OCC operator will then be able to hear the environment of the selected train. During the OCC central monitoring, the selected train can still broadcast ATC initiated automatic audio announcement. The selected train can still broadcast live announcement made by SI, TC initiated automatic audio announcement.

5. OCC 的操作員於 CMFT 操作畫面結束監聽的功能。

The OCC operator terminates central monitoring function on the CMFT operation screen.

6. 然後 CMFT 伺服器會送出中斷中央監聽的要求給 TRIU，所選擇的列車組的 PI 就會自動切斷這個功能。

CMFT Server will terminate the audio channel and send the terminate central monitoring request to TRIU. All the PIs of the selected train will be switched off automatically.







predefined audio messages requested by CC will be prohibited. The “OCC Call” position LED will flash.

2. 列車組的 TRIU 透過 TETRA 數位無線電傳送一個 SI 的呼叫給 CMFT 伺服器。SI 的呼叫會通知 CMFT 伺服器有一列車組的 SI 提出呼叫。

The TRIU of the train sends a SI call request to the CMFT Server via the TETRA digital radio communication Network. The SI call request will notify the CMFT Server that there is a SI call requesting from the train.

3. 在所有 CMFT，只要沒有被佔用的，再螢幕上將會顯示 SI 的呼叫以提醒 OCC 的操作員有列車的提出 SI 的呼叫要求。

The CMFT which is not being occupied will show up the SI call request on the screen to alert OCC operator that there is SI call request from the train.

4. 提出呼叫的 SI 的資訊包括車輛 ID 及 SI 號碼將會顯示在 CMFT 上，然後操作員可選擇”Answer call”功能來起始 SI 通話。

The incoming SI call information including vehicle ID and SI number will display in all CMFT. The operator answers the call by select the answer call function.

5. 此時，CMFT 和 SI 間的半雙工語音通訊就會建立起，且“OCC CALL”位置的 LED 燈會恆亮。

The half duplex audio communication channel between the CMFT and the triggered SI will be established and the “OCC CALL” position LED will steady on.

6. 只有 OCC 的操作員可結束 SI 的通訊。當 OCC 的操作員於 CMFT 操作畫面上結束與 SI 間的通話，CMFT 伺服器就會送出中段中斷要求給 TRIU 以通知結束 SI 通訊的頻道，然後，所有的語音通訊就會中止且 TRIU 會終止該車組的所有被按下的 SI，在“OCC CALL”位置的 LED 的按鍵燈將會熄滅。

The SI conversation can only be terminated by OCC operator. When the OCC operator terminates the SI conversation on CMFT operation screen, CMFT Server will be notified to terminate the SI audio communication channel by sending the SI call terminate request to TRIU of the triggered SI. The Audio communication channel will be terminated and the TRIU will turn off all triggered SI(s) of that train. The “OCC CALL” position LED of the triggered SI will be steady off.

### **3.4.2 由服務對講機進行口語廣播 LIVE ANNOUNCEMENT VIA SERVICE INTERCOM**

在需要的時候，列車駕駛員可透過服務對講機進行對全列車的口語廣播。

If necessary, the train driver is required to have a live announcement to on-train speakers throughout the train made through the service intercom.

服務對講機對全列車的口語廣播的操作和功能如下說明：

The functions and operation flow of the on train live announcement made through the service intercom are shown as follow:

1. 列車駕駛員按下 TRCP 控制面盤的“Local PA” 按鍵燈，所有目前由 OCC 或 CC 所建立的廣播都會被中斷，所有由 OCC 的預錄廣播、口語廣播或由 TC 建立預錄廣播都會被拒絕，在“Local PA”位置的 LED 將會亮起。

Train driver press the “Local PA” button in the TRCP. All current broadcasting audio messages wherever initiated by OCC or CC will be interrupted immediately. The function of the Live announcement from OCC, predefined audio message from OCC, OCC central monitoring and predefined audio messages requested by CC will be prohibited. The “Local PA” button LED in that train radio control panel will be steady on.

2. 該列車組的 TRIU 將會通知 CMFT 伺服器，服務對講機開始進行口語廣播，CMFT 將不會允許 OCC 的口語廣播、預錄廣播和 OCC 的監聽功能。

The TRIU of that train will notify the CMFT Server that the Live announcement made through the service intercom is broadcasting throughout train. CMFT will not allow the user to make the live announcement from OCC, predefined audio messages from OCC or OCC central monitoring to that train.

3. 當列車駕駛員要結束廣播時，將手持式喇叭麥克風的 PTT 放開，再按一次“Local PA”按鍵，此時在 TRCP 控制面盤上的“Local PA”按鍵的 LED 將熄滅，TRIU 就會將對列車的廣播關閉，並通知 CMFT 伺服器，服務對講機的口語廣播終止。

To terminate the live announcement made through the service intercom, the train driver will release the PTT of the handheld speaker microphone and press the “Local PA” button again. Simultaneously, the “Local PA” button LED in that train radio control panel will be steady off and the TRIU will turn off all the on-train speakers and will notify the CMFT Server that the live announcement made through service intercom is terminated.

### **3.4.3 服務對講機與 PI 的半雙工通訊 SERVICE INTERCOM HALF DUPLEX COMMUNICATION WITH PI**

當列車切換至手動駕駛模式時，駕駛員可使用 SI 接聽來自 PI 的旅客通話。

When the train switches to manual mode operation, the Train driver can use the SI answering passenger from the PI call.

服務對講機與 PI 的半雙工通訊操作流程和功能如下說明：

The functions and operation flow of the half duplex PI voice communication with SI are shown as follow:

1. 當列車切換至手動駕駛模式時，駕駛員按下的 PI Master 鍵，OCC 將接獲 PI 主控權切換訊息，列車上的 PI 語音通道切換至 SI 主控，PI Master 鍵燈恆亮。

When the train switches to manual mode operation, the Train Operator press the PI Master Key on the TRCP, OCC will receive the PI mastership switch message, PI voice channels will switch to the SI master, PI Master Key lights **On**.

2. 當旅客按下 PI 緊急通話按鈕時，TRCP 上的 PI 鍵燈閃爍，SI 發出震鈴聲，此時駕駛員按下 PI 鍵即可接聽，透過 SI 與旅客通話。**相關操作流程如附件十。**

When passenger press the PI emergency call button, the PI key light flashing and SI ringtone on the TRCP, the Train Operator presses the PI button to answer calls through the SI . **Related operation flows, please see Appendix 10.**

### 3.5 觸動列車 CCTV 的告警 THE ALARM OF ON-TRAIN CCTV TRIGGERING

TRIUI 將經由乙太網路界面接收到列車控制器傳送來的偵煙器和緊急把手狀態以及正線非停於車站之列車非預期開門的告警，再經由 TETRA 數位無線電將告警送回 OCC 的 CMFT 伺服器。

TRIUI will get from CC via the Ethernet interface the status of “Smoke Detectors” and “Emergency Pull Handles” and “doors are unexpectedly opened when train stopped outside the station” then send the status back to OCC CMFT Server as the SDS by TETRA Radio communication network.

功能和運作流程如下說明：

The function and operation flow of triggering these alarms:

1. 列車控制器將告警訊息送至 TRIUI。

The CC will send the status alarm message to the TRIUI.

2. TRIUI 透過 TETRA 無線通訊網路將告警通知 CMFT 伺服器。

The TRIUI will notify CMFT Server by sending the alarm through TETRA Radio communication network.

3. CMFT 伺服器會通知 OCC 影像控制伺服器該告警的列車 IP 位置，而影像控制伺服器將通知螢幕控制器去接收該列車組的 8 支 IP 網路攝影機的影像，IP 網路攝影機會將影像透過 DCS 網路傳送回至 OCC 並透過螢幕控制器顯示在 OCC 的電視牆的第 15 和 16 台顯示器上，顯示器將以四分割畫面顯示該事件列車，CMFT 伺服器將會記錄下告警的列車 ID 和車廂 ID。

CMFT Server will notify OCC Video Control Server with the IP address of the train which has just made the alarm. The Video Control Server will request monitor controller retrieve 8 IP camera videos from that train. IP camera videos will start to send the video streaming back to monitor controller via DCS network. The IP camera videos will be displayed in monitor 15 and monitor 16 of video wall in OCC. Each of them will display 4 IP camera videos in quad screen pattern of each the incident train. CMFT Server will record the alarm with Vehicle ID and Car ID.

4. 告警的列車 ID 和車廂 ID 的資訊將會顯示在 CMFT 的畫面上。

The alarm information including Vehicle ID and Car of incident train will display in all CMFTs.

5. 當 OCC 的操作員以滑鼠敲擊緊急資訊的按鍵時候，告警的列車 ID 和車廂 ID 的資訊將會顯示出來。

When the OCC operator clicks the emergency information button of train, the information of the Vehicle ID, Car ID of the incident train will be displayed.

6. TRIUI 會保持告警的狀態，如果他們被重置，TRIUI 將會通知 CMFT 伺服器終止告警且緊急訊息將會從 CMFT 上移除。CMFT 伺服器也會通知影像控制伺服器停止該列車螢幕監看。

The TRIUI will keep check the status of alarm. If they have been reset, the TRIUI will notify CMFT Server to terminate the alarm and the emergency information of the incident train in CMFT will be removed. CMFT Server will also request Video Control Server stop monitoring the train.

告警如當驅動偵煙器或啟動緊急把手的資料流程圖，請參考圖 3-13。

Please refer to Figure 3-13 for the system data flow during alarms such as smoke detector and emergency handle pulled.

### 3.6 旅客資訊顯示器 **PASSENGER INFORMATION DISPLAYS (PIDs)**

在 TRIU 的 PID 的操作模式包含兩個等級(由低等級至高等級)，由自動預錄文字訊息(列車控制模式:低等級)和由 OCC 傳送的訊息(高等級)。下面將說明這兩種模式的特性。

There are two priorities of PID operation modes in TRIU. (From the lowest priority to highest priority): Automatic Predefined text message (Train Control Mode: lowest priority) and Text messages requests made by OCC(highest priority). The follow will show the operation characteristics of each mode.

1. 當 TRIU 接收到較高或同等級或是相同等級的新 PID 訊息時，TRIU 將會停止顯示目前所顯示的文字訊息(即使原訊息未顯示完)以顯示新訊息。

When TRIU receives higher or same priority request of new PID operation mode then the current PID operation mode in TRIU, TRIU will stop to display the current text message (even if not finished) but will display the new text message.

2. 在 TRIU 在預設的情況下將在列車控制模式。

TRIU will be at Train Control Mode by default.

3. 當 TRIU 重複完成顯示或 TRIU 接收到 CMFT 伺服器清除 PID 的訊息時，TRIU 將回到列車控制模式。

When the TRIU completely display all required repetitions text message or CMFT Server sends the clear PID message to TRIU, it will cause the TRIU to return back to Train Control Mode.

#### 3.6.1 自動預錄文字訊息(列車控制模式) **AUTOMATIC PREDEFINED TEXT MESSAGE (TRAIN CONTROL MODE)**

當 TRIU 由乙太網路介面接收到 CC 來的事件如列車到站，TRIU 就會將對應的文字訊息藉由另一乙太網路介面傳送至該車組的 24 台 PID，PID 就會開始顯示對應的文字訊息，在 PID 顯示的同時，OTC 將開始進行對應訊息的預錄廣播，下列的預設訊息由 CC 啟動並顯示在 PID 上。

Once the TRIU receives events from the CC through Ethernet interface such as stations of train position, the TRIU will send the required event text messages to 24 PIDs within the train through another Ethernet interface. The PIDs will display the event text messages once received it. When displaying the text messages, OTC will also make audio announcement about the content of text message through the saloon speakers if necessary. The following predefined text messages requested by CC will be displayed on PID:



1. 目前站名 Name of current stations
2. 下一站名 Name of next stations
3. 終端站名 Name of terminal station
4. 車門關閉訊息 Doors closing message
5. 轉乘站訊息 Transfer station

TRIUI 會保存所有的預錄訊息，TRIUI 將提供 200MB 儲存容量儲存列車預錄廣播的訊息內容和乘客資訊顯示內容文字，而維修人員將透過 TRIUI 的故障偵測埠進行列車預錄廣播的訊息內容和乘客資訊顯示內容更新，TRIUI 將控制乘客資訊顯示同步顯示列車預錄廣播的訊息內容。

The TRIUI will archive all the predefined text messages. TRIUI will provide 200MB capacity to store the content of predefined audio and predefined text message of PID. Maintenance staff can update the content of predefined audio and predefined text message of PID via diagnose port of TRIUI. TRIUI will also control PIDs to display the message synchronously as the content of predefined audio.

### 3.6.2 由 OCC 輸入的文字訊息 TEXT MESSAGES REQUESTS MADE BY OCC

為通知旅客一般的服務訊息或特別的資訊時，OCC 操作員可輸入 PID 文字訊息或選擇預設的訊息至所有列車或所選擇的列車或單一系列車。

To inform the passenger the revenues service condition and other special information, OCC operator can send either predefined PID text messages or free text message from OCC to all the trains, one selected train or group of trains.

由 OCC 輸入文字或傳送預設訊息的功能操作如下說明：

The functions and operation flow of sending OCC to train predefined text messages and Free text messages are shown as follow:

1. OCC 操作員選擇列車。  
An OCC Operator selects the train(s).
2. OCC 操作員在 CMFT 上選擇預設訊息或輸入文字訊息。若選擇預設訊息將顯示於所選的列車，或由 OCC 操作員在 CMFT 上輸入中文和英文並顯示在所選的列車。OCC 的操作員可選擇數個重覆的顯示預設訊息或文字輸入訊息。

The OCC operator can either choose to make predefined text messages or free text message on CMFT. To make predefined text messages, OCC operator can choose what predefined text message will display on the PID of selected train(s). Or the OCC operator can types the free text message in Traditional Chinese and English in CMFT if the OCC operator makes free text message to the selected train(s) . The OCC operator can also select the number of repetition of displaying those predefined text messages and free text messages.



3. 當 OCC 操作員確認預設訊息或文字輸入後，CMFT 伺服器將會透過 TETRA 數位無線通訊網路將訊息傳送至所選擇的列車的 PID。

When the OCC operator confirms to make predefined text message or free text message to the selected train(s), the CMFT Server will send the PID request to the selected train(s) through TETRA Radio communication network.

4. 當選擇的列車的 TRIU 收到 OCC PID 的顯示要求，就會改變操作的操作模式為 OCC 的模式，並傳送一個回應的訊號給 CMFT 伺服器表示接收成功，所有所選擇的 PID 將停止目前的顯示。

After received the OCC PID request, the TRIU of selected train(s) will change the PID operation mode to text message requests made by OCC mode. The TRIU will send the acknowledgement back to CMFT Server once received the PID request successfully. All the PIDs of the selected train(s) will stop to display the current text message immediately.

5. 然後 CMFT 伺服器就會將訊息傳送至所選擇的 TRIU，TRIU 再藉由乙太網路介面將訊息傳送至該列車的 PID。

The CMFT Server will then send the predefined text messages or free text messages to the TRIU of selected train(s). The TRIU will send those text messages to all the PIDs of the train through Ethernet interface for display text messages requested by OCC.

6. PID 將會依照所對應的預設訊息代碼的文字顯示。

The PIDs will repeatedly display the text messages in accordance with the number of repetition pre-set by OCC operator.

7. 當訊息顯示完成，TRIU 將會透過 TETRA 數位無線通訊網路通知 CMFT 伺服器。

When the repetition of displaying the text messages are completed, the TRIU will notify CMFT Server through TETRA Radio communication network.

8. OCC 的操作員可在 CMFT 上按"STOP"的按鍵，以停止目前 PID 上由 OCC 啟動文字顯示，CMFT 伺服器將傳送清除 PID 顯示並將模式切換回列車控制模式。

OCC operator can stop the current text message from OCC on PIDs by pressing the "STOP" buttons in CMFT. The CMFT Server will send a Clear PID message to the TRIU to clear the PID display and change the TRIU PID operation mode back to the Train Control Mode.

### 3.7 網路交換器 ETHERNET SWITCH

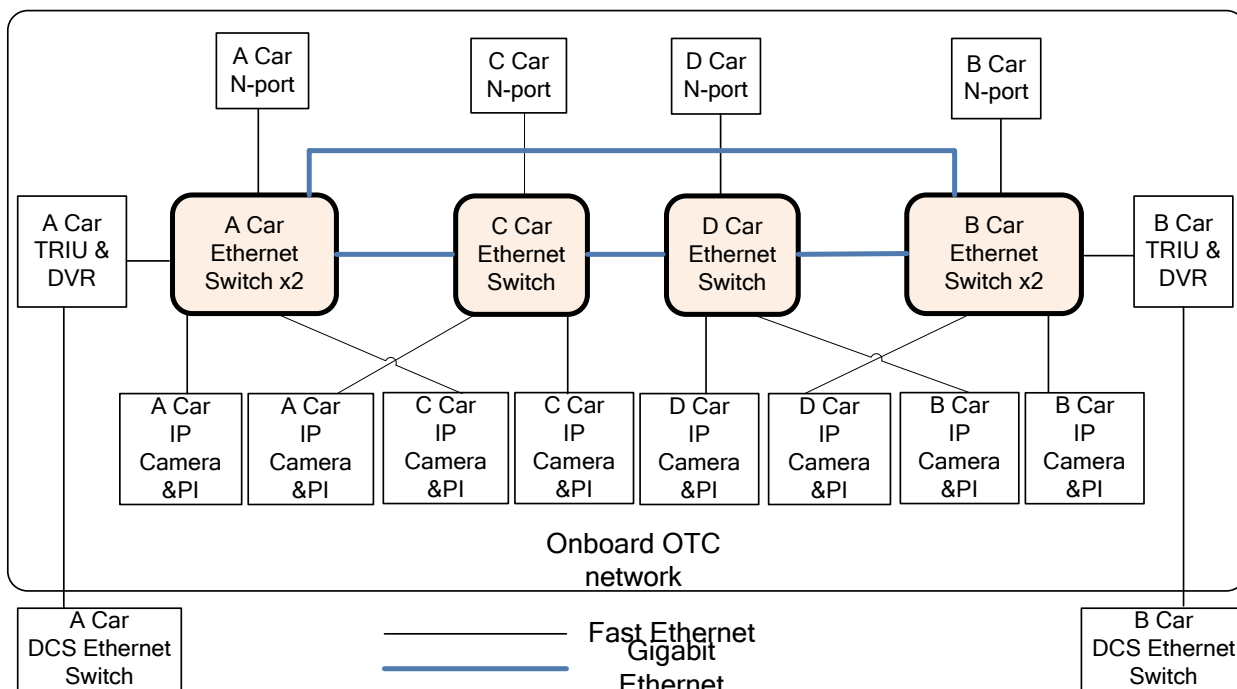


圖 3-15 OTC 網路交換器與各設備連接圖

Figure 3-15 Network architecture of OTC Ethernet Switch and each equipment

列車通訊系統將於將於 A 車廂和 B 車廂裝兩台網路交換器於 C 車廂和 B 車廂裝一台網路交換器，並提供列車通訊設備 PI、TRIU 及其他子系統設備網路連接，包括列車旅客資訊顯示系統的 N-port、列車閉路電視系統的 IP 網路攝影機、DVR 等如上圖所示。網路交換器會與各車廂之網路交換器彼此互相連接，而整列車的網路交換器相連將構成一個列車通訊網域，提供列車通訊設備彼此間資訊交換。

OTC system will install two Ethernet switches in A car and B car, and one Ethernet switch in C car and D car. It provides network connection for on train communication equipment such as PI, TRIU and other subsystem including on train PID system such as N-port and on train CCTV system such as IP cameras and DVR as shown on above figure. Ethernet switch will connect to each other in each car. All switches in one train will make an on train communication network and provide the on train communication equipment to exchange the information.

網路架構支援快速生成樹協定(RST protocol)，可有效縮短環的保護切換時間，環狀架構的保護切換如圖 3-16 所示。

The ring network architecture support Rapid Spanning Tree protocol (RST protocol), which can effectively reduce the ring protection switching time, the protection switch of ring structure as shown as Figure 3-16.

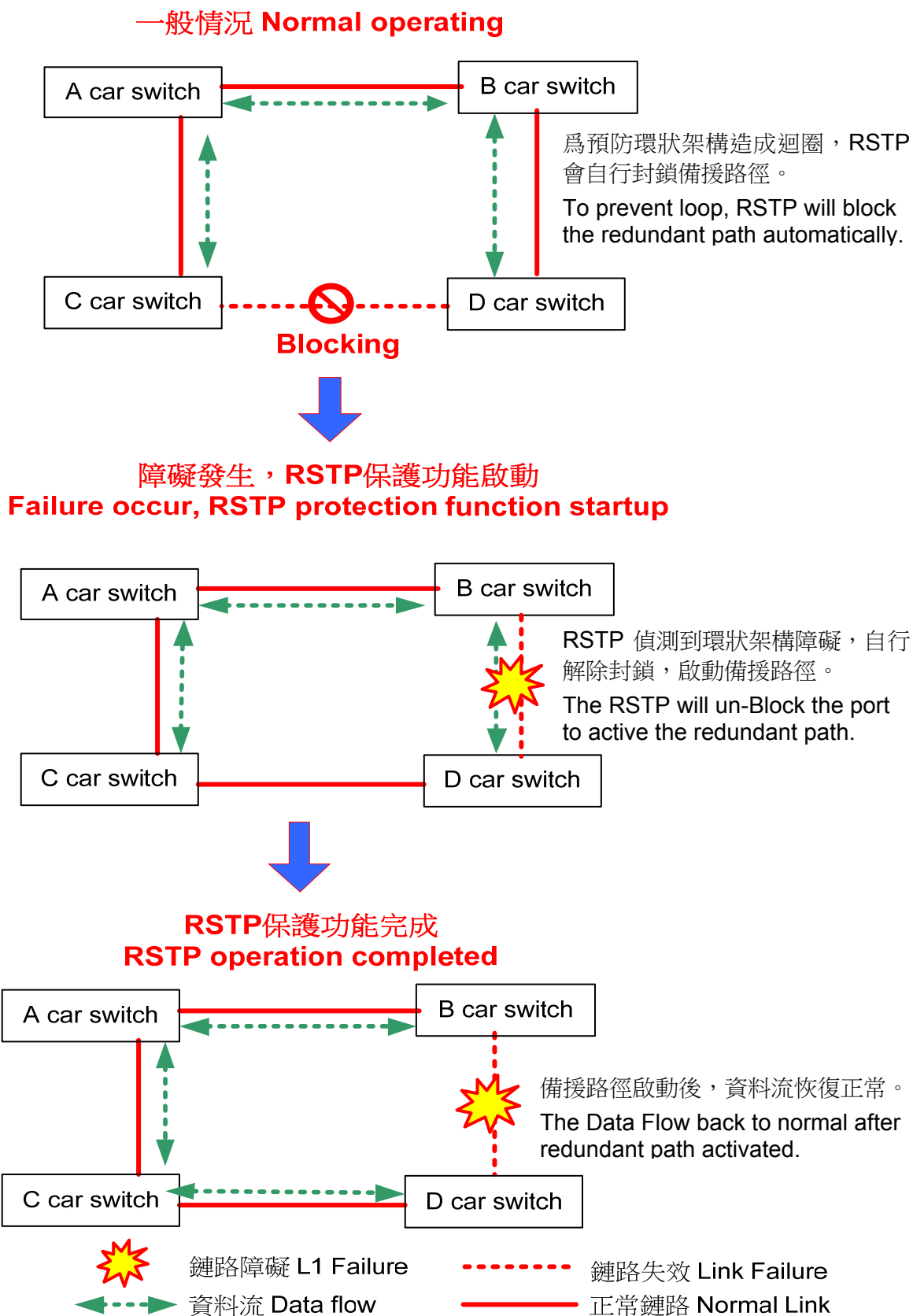


圖 3-16OTC 網路交換器路由保護機制  
Figure 3-16 Network switch routing protection mechanisms

網路交換器提供快速乙太網路介面給各通訊設備，而網路交換器與網路交換器間的網路介面為超高速乙太網路。每台網路交換器將可以提供 8 組快速以太網路介面(其中四組有乙太網路供電功能)與兩組超高速乙太網路介面。

Ethernet switch provides fast Ethernet interface to each communication equipment. The interface will be gigabit Ethernet between switch and switch. Every Ethernet switch can provide 8 fast Ethernet interfaces (4 of them have POE function) and 2 gigabit Ethernet interfaces.

在列車通訊網路內，OTC 網路交換器與 DCS 網路交換器並沒有相連接，意思代表彼此網路是互相獨立。而在通訊設備中，只有列車通訊系統設備的 TRIU 和列車閉路電視系統的 DVR 會有網路介面與 DCS 網路交換器相連接。

In OTC network, OTC Ethernet switch do not connect to DCS Ethernet switch. It means that OTC switch and DCS switch are independent. In communication equipment, only TRIU of OTC system and DVR of on train CCTV system will connect to DCS Ethernet switch.

### 3.7.1 網路交換器的功能 FUNCTION OF ETHERNET SWITCH

車上網路交換器，其功能說明分別如下

Ethernet switch provides following functions.

- 車上網路交換器為網管型網路交換器。  
The type of on train Ethernet Switch is Managed Ethernet switch.
- 每台網路交換器將可以提供 8 組快速乙太網路介面與兩組超高速乙太網路介面。  
Every Ethernet switch will provide 8 fast Ethernet interfaces and 2 gigabit Ethernet interfaces.
- 連接車廂和車廂間之間的網路  
Connect the network between car and car.
- 提供虛擬區域網路(VLAN)功能來區分不同網路服務。  
Provide VLAN function to divide the different network service.
- 提供繼電器直通功能於車廂和車廂之間的網管型網路交換器連接，當網路交換器電源失效後，仍不影響前後節車廂的網路連接。  
Provide Relay-By-Pass function to connect managed switch between car and car. When power of switch fails, the network connection of front car switch and back car switch will not be affected.
- 提供生成樹功能，來防止網路迴圈的問題。  
Provide Spanning Tree function to prevent the network loop problem.
- 提供 8 組乙太網路連接埠其中四組乙太網路連接埠有乙太網路供電功能並提供連接 PI 和 IP 網路攝影機。

Provide 8 fast Ethernet ports and 4 of them have POE function to connect PI and IP camera.

- 提供 DHCP 功能並自動指派 OTC 設備網路 IP 位址。

Provide DHCP function to assign OTC equipment network IP address automatically.

### 3.7.2 設備的網路配置 EQUIPMENT NETWORK CONFIGURATION

列車通訊設備的配置將分為內部網路和外部網路，OTC 網路將設定為內部網路，在內部網路，每一列車的通訊設備的網路 IP 設定為一樣的，不會因為每台列車而有不同設定。而通訊設備與 DCS 網路相接是為外部網路，外部網路的通訊設備於每一列車將有獨立的網路 IP 設定。

On train communication equipment will configure into internal network and external network. OTC network is internal network. In internal network, communication equipment will configure with same IP address in every train and will not have different network configuration in different train. The external network is the communication equipment connecting to DCS switch. In external network, communication equipment will have different IP address configuration in each train.

內部網路的設備包含 TRIU 的內網埠、N-port、PIs、IP 網路攝影機和 DVR 的內網埠，各內部網路的設備之間網路通訊都是經由 OTC 網路交換器作為傳輸骨幹互相傳送資訊，內部網路的主要通訊資訊有包含 PI 車內語音通訊、TRIU 對 N-port 的車內 PID 文字顯示訊息、IP 網路攝影機對 DVR 的影像傳輸、以及 TRIU 對 DVR 交換 NTP 校時通訊使用。

Equipment of internal network includes internal Ethernet port of TRIU, N-port, PIs, IP cameras and internal ethernet port of DVR. Each equipment of internal network transmits information to each other via OTC Ethernet switch as a transmission backbone. The mainly communication information includes PI voice communication signal, PID display signal between N-port and TRIU, video signal between IP camera and DVR, NTP signal between TRIU and DVR.

而外部網路的設備包含 DVR 的外網埠以及 TRIU 的外網埠，外部網路主要是 TRIU 與 CC 間列車訊息通訊、DVR 對 OCC 列車監視影像的傳送，而 OTC 外部網路的 IP 設定於每台列車上都是不同的，將配合 DCS 網路做設定。A 車之 TRIU 和 DVR 將連接於 A 車之 DCS 網路交換器和 B 車之 TRIU 和 DVR 將連接於 B 車之 DCS 網路。

Equipment of external network includes the external Ethernet port of DVR and the external Ethernet port of TRIU. External network transmits mainly video signal from DVR to OCC and the train information between TRIU and CC. The IP address of external network is different in different train and coordinates with DCS network. A car's TRIU and DVR will connect to A car's DCS switch. B car's TRIU will connect to B car's DCS switch.



表 3-7：列車通訊設備與 OCC 資料傳輸說明

Table 3-7: Context of OTC communication equipments and OCC data transaction

NOV 11, 2014



項目 Item	從通訊設備 From equipment	通訊系統介面 Communication system Interface	到通訊設備 To Equipment	說明 Description
3	DVR	DCS 網路 DCS Network	OCC	DVR 端及 OCC 端資料透過 DCS 網路系統進行雙向資料傳輸 DVR transmit by DCS network to OCC bi-directionally

### 3.7.3 網路交換器的網路流量分析 TRAFFIC ANALYSIS OF ETHERNET SWITCH

列車通訊設備的 OTC 網路交換器頻寬需求如下列表。

Network bandwidth requirement of each equipment for OTC switch as following table.

表 3-8：列車通訊設備的 OTC 網路交換器頻寬需求

Table 3-8: Network bandwidth requirement of each equipment for OTC switch

項目 Item	從通訊設備 From equipment	到通訊設備 To Equipment	頻寬估算 Bandwidth calculate	說明 Description
1	IP 網路攝影機 IP Camera	數位錄影機 DVR	800kbps	列車即時影像傳輸至行控中心監控需求 Bandwidth requirement of one of onboard real-time video stream transmit to OCC for surveillance.
2	IP 網路攝影機 IP Camera	數位錄影機 DVR	2Mbps	每一支列車 IP 網路攝影機傳送給列車 DVR 錄影之影像頻寬需求 The bandwidth requirement of each onboard IP camera transmits to onboard DVR for recording.
3	旅客對講機 PI	TRIUI	200kbps	每一支旅客對講機傳送給 TRIUI 錄影之語音頻寬需求 The bandwidth requirement of each PI transmits to TRIUI for voice communication.
4	數位錄影機 DVR	TRIUI	20kbps	每一 DVR 傳送給 TRIUI 之時間校時訊號的頻寬需求 The bandwidth requirement of each DVR transmits to TRIUI for NTP communication.
5	TRIUI	N-Port	100kbps	每一 TRIUI 傳送給 N-port 之 PID 控制訊號頻寬需求 The bandwidth requirement of each TRIUI transmits to N-port for PID communication.



列車通訊設備對於 DCS 網路交換器頻寬需求如下列表。

Network bandwidth requirement of each communication equipment for DCS switch as following table.

表 3-9：列車通訊設備對於 DCS 網路交換器頻寬需求

Table 3-9: Network bandwidth requirement of each equipment for DCS Switch

項目 Item	從通訊設備 From equipment	到通訊設備 To Equipment	頻寬估算 Bandwidth calculate	說明 Description
1	數位錄影機 DVR	OCC	800kbps	列車即時影像傳輸至行控中心監控需求 Bandwidth requirement of one of onboard real-time video stream transmit to OCC for surveillance.
2	TRIU	CC	100kbps	每一 TRIU 與 CC 控制訊號頻寬需求 The bandwidth requirement of each TRIU and CC communication.

### 3.8 列車通訊優先權說明 ON-TRAIN COMMUNICATION PRIORITY DESCRIPTION

列車優先權次序是由 TRIU 控制，來源及功能優先等級如下：

The OTC system priorities are by TRIU control, source and function of priorities as follows:

旅客對講機 > 服務對講機對 OCC 或廣播 > OCC 廣播 > OCC 對旅客對講機監聽 > CC 預錄廣播

PI > SI to OCC or PA > OCC to PA > OCC to PI CM > CC predefined PA

以下將說明行控與司機員各自於使用通訊狀況下，其設備間功能相互影響說明：

The devices feature interaction description as OCC operator and driver in use communication situation respectively as below:

表 3-10: OCC 已成立與駕駛員間的相互影響  
Table 3-10: OCC has been established the interaction between the driver

		OCC 使用中(已成立) OCC is in use (Established)			
		PI	SI	PA	Car Monitor
駕駛員欲執行 Driver want to execute	PI	無法使用 Can not use	駕駛員決定 Driver decision	可並行 Parallel	覆蓋原使用功能 Overwrite the original function
	PA	可並行 Parallel	無法使用 Can not use	駕駛員決定 Driver decision	可並行 Parallel

1. OCC 已與 PI 通話中：

When the communication between OCC and PI is established:

A. 駕駛員無法再使用 SI 與 PI 建立通話。

The driver cannot use SI to communicate with PI.

B. 駕駛員可以再使用 SI 做透過 PA 廣播，此為並行狀態。

The driver can use SI to do PA broadcasting, which is a parallel status.

2. OCC 已與 SI 通話中：

When the communication between OCC and SI is established:

A. 駕駛員可以人為選擇切斷與 OCC 通話，再使用 SI 接聽 PI。(由駕駛員人為決定)

The driver can manipulate the TRCP to cut off communication, and then use SI to answer the PI call request or continue communicating with OCC. (The operation decision is made by the driver)

B. 駕駛員無法切斷與 OCC 通話，使用 SI 透過 PA 做廣播。

The driver cannot cut off the communication with OCC to do new action which using SI to do PA live announcement.

3. OCC 已透過 PA 執行廣播中：

When the OCC is doing PA announcement:

A. 駕駛員可以同時透過 SI 接聽來自 PI 的通話要求，此為並行狀態。

The driver can use SI to answer the PI call request, which is a parallel status.

B. 駕駛員可以人為選擇切斷 OCC 廣播而自己使用 SI 執行 PA 廣播。(由駕駛員人為決定)

The driver can make a decision to cut off the PA announcement from OCC and then use SI to do PA live announcement. (The operation decision is made by the driver)

#### 4. OCC 已透過 PI 做 Car Monitor 中：

When the Car Monitor function is activated by OCC:

- A. PI 被啟動後會自動切斷 CM 功能，而駕駛員可以透過 SI 接聽 PI 通話要求 (OCC 也可接聽 PI 通話要求)。

If the PI call request is activated, the PI will automatically terminate the Car Monitor function. And then, the driver can use SI to answer the PI call request (OCC can answer the PI call request too if the PI Master has been activated.)

- B. 駕駛員可以同時使用 SI 執行 PA 廣播，此為並行狀態。

The driver can use SI to do PA live announcement at the same time, which is a parallel status.

表 3-11: 駕駛員已成立與 OCC 間的相互影響

Table 3-11: Driver has been established the interaction between the OCC

		Driver 使用中(已成立) Driver is in use (Established)	
		PI	PA
OCC 欲執行 OCC want to execute	PI	無法使用 Can not use	可並行 Parallel
	SI	無法使用 Can not use	無法使用 Can not use
	PA	可並行 Parallel	無法使用 Can not use
	Car Monitor	無法使用 Can not use	可並行 Parallel

#### 1. 駕駛員已使用 SI 與 PI 通話中：

When the driver is using SI to communicate with PI:

- A. 駕駛員已執行接聽 PI，OCC 無法再接聽 PI。

The driver has answered the PI call request, and therefore OCC cannot answer the PI call request again.

B. 駕駛員無法再與 OCC 通話，因為 PI 來源優先權高於 SI。

The driver cannot communication with OCC, because the PI of source priority is higher than SI.

C. OCC 可以同時進行 PA 廣播，此為並行狀態。

The OCC can do PA announcement on trains at the same time, which is a parallel status.

D. OCC 無法再透過 PI 進行車廂監聽。

The OCC cannot use the PI to do Car Monitor function at the same time.

2. 駕駛員已使用 SI 進行 PA 廣播：

The driver is using the SI to do PA live announcement:

A. OCC 可以同時接聽來自 PI 的通話要求，此為並行狀態。

The OCC can answer the PI call request at the same time, which is a parallel status.

B. OCC 無法與 SI 通話。

The OCC cannot communicate with SI on the train.

C. OCC 無法進行 PA 廣播。

The OCC cannot do PA announcement on the train.

D. OCC 可以同時透過 PI 進行 Car Monitor，此為並行狀態。

The OCC can use the PI to do Car Monitor function, which is a parallel status.

## 4 系統設備細部配置規範 **SYSTEM EQUIPMENT SPECIFICATIONS**

本章將對列車通訊系統的設備及零組件的設備規格做說明。詳細請參考 TC1-6A205 - 列車通訊系統 - 設備規格文件。

This section will describe the equipment specifications for On Train Communication System equipments and components. For the complete specification please refer to the document TC16A205 - On Train Communication - Equipment Data Sheet.

### 4.1 TETRA 無線電車機 **TETRA RADIO MOBILE UNIT (TROU)**



#### 4.1.1 設備說明 **EQUIPMENT INTRODUCTION**

基於開放標準及商業化技術，TETRA 無線電車機可幫助解決許多長期營運下的所屬權問題，包括維護與備份。使用開放式 TETRA 標準及商業化產品結合為 TROU，其設備安裝於列車組手動駕駛室面板旁與無線電控制面板及無線電介面單元相互整合。

The selection of the TETRA radio terminal is based on open standards and commercially available technology, which can help to solve many of the proprietary issues for long term operation, maintenance and spare part issues. The underlying principle behind is the use of open TETRA standards and commercial off-the-shelf product to be integrated as the On-train controller (TROU) that will be installed around the manual driver console at the both end of the train.

OTC 系統中 TROU 是選用 Sepura SRG3900 為無線電車機，作為列車及行控中心之間的語音及數據通訊傳輸介面。SRG3900 俱備不同的通訊頻段，在 OTC 系統所選用的頻寬為 380MHz 到 430MHz。

As SEPURA TETRA SRG3900 radio terminal has been undergone various interoperability test with a number of TETRA infrastructures, e.g., Marconi/OTE EADS, Motorola, etc., SRG3900 is selected for the On-train Radio Communication System. SRG3900 will be integrated with the TRCP and the TRIU (On Train Communication controller) installed around manual driver

console at the both end of the train and will provide voice and data communication services between Train Operator and Central Control. SRG3900 can be operated in different frequency band and the selected unit will be operated in frequency band of 380MHz to 430MHz.

每一列車組前後兩車頭手動駕駛面板附近提供一組 TETRA 無線電車機。

One TETRA radio terminal will be provided in each manual drive console at the end of the train.

#### 4.1.2 設備規格 EQUIPMENT SPECIFICATION

Sepura SRG3900 規格條列如下所示：

The specification of the Sepura SRG3900 radio terminal is listed in the following:

頻寬

Frequency Bands : 380 to 430 MHz

RF 功率輸出

RF Power output : 10 Watts in TMO and DMO

操作溫度

Operating Temperature : -30°C to +70°C

通話群組

Talk Group : Support for up to 9900 pre-programmed Talk groups and in any combination of TMO or DMO talk groups

電源供應

Power Supply : 10.8 to 15.6V DC, typical 13.8V DC

尺寸

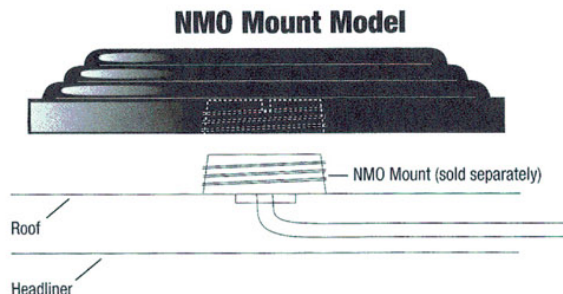
Dimension : 205mm W X 54mm L X 108mm D  
(Including fixed base plate)

重量 Weight

: 980 g



## 4.2 無線電天線 TETRA RADIO ANTENNA



### 4.2.1 設備說明 EQUIPMENT INTRODUCTION

列車無線電通訊系統使用的車機天線型號為 NMO4020 Low Profile，天線將安裝於駕駛室的車頂下方。天線接收無線電訊號所使用的頻寬從 410 到 430 MHz。每個駕駛室提供一個車機天線。

The mobile antenna used in the On-train Radio of Communication System is a low profile antenna type with NMO Mount model. It will be mounted under the roof of the driver's cab. The mobile antenna will be used to receive radio signal at the frequency band 410 to 430 MHz. One antenna will be provided in each operator's cab.

### 4.2.2 設備規格 EQUIPMENT SPECIFICATION

Low Profile 天線 NMO4020 規格說明如下所示：

The specification of the LoPro Low Profile antenna NMO4020 is as follows:

操作頻率

Operating Frequency : 410 to 430 MHz

天線增益

Antenna Gain : 3dB

VSWR 比值

VSWR at Resonant Point : 2:1 or less

公稱阻抗

Nominal Impedance : 50 Ohms

輻射圖騰

Radiation Pattern : Omni-Directional

極化方向

Polarization : Vertical

最大輸入功率

---

Maximum Power Input	:	125 Watts
接地平面		
Ground Plate Required	:	Yes
顏色		
Color	:	Black
尺寸		
Dimensions	:	192mm (DIA) X 100mm (H)

### 4.3 TETRA 無線電介面單元 TETRA RADIO INTERFACE UNIT(TRIU)



#### 4.3.1 設備特點和應用 EQUIPMENT FEATURE AND APPLICATION

這章節是描述列車 TETRA 無線電介面單元的規格.它將提供以下的功能。

This chapter describes the equipment specifications of the TETRA Radio Interface Unit. The TRIU will support the following functions:

提供無線電控制面板以及 TETRA 無線電車機之間的控制及語音通道供廣播及緊急通話模式使用。

Provide the control & speech paths between the TETRA Radio Control Panel (TRCP) and the TETRA 無線電車機 (TROU) for PA and Passenger Intercom mode;

提供 TETRA 無線電車機的語音及控制介面。

Provide audio and control interface for Tetra Mobile Radio Terminal;

提供 TETRA 無線電控制面板的語音及控制介面。

Provide audio and control interface for TETRA Mobile Radio Terminal;

提供對廣播語音的音頻平衡及不同語音模式的語音開關。

Provide audio balance and different mode audio switch to the PA audio speech;

提供旅客緊急通話器語音及控制介面。

Provide audio and control interface for Passenger Intercom Unit

提供旅客資訊顯示單元資料及控制介面。

Provide data and control interface for Passenger Information Display Unit

提供列車控制器資料介面作資訊交換。

Provide data interface for Carborne Controller for data exchange

提供前後兩端列車無線電介面單元作資料交換。

Provide data interface between both end of TRIU for data exchange

每一組列車兩端將提供一組列車 TETRA 無線電介面單元。

One TRIU will be provided in both end of train.

#### 4.3.2 設備規格 EQUIPMENT SPECIFICATION

##### 4.3.2.1 電力規格 POWER SPECIFICATION

TRIU	
輸入電壓 Input Voltages	110VDC
輸出電壓 Output Voltages	12 VDC 包括工業電腦、音訊通道控制器、TROU 及 TRCP。 12VDC include IPC、Audio Switch、TROU and TRCP. 48 VDC 功率放大器 48VDC Power Amplifier

##### 4.3.2.2 介面規格 INTERFACE SPECIFICATION

PID 旅客資訊顯示介面 (經由網路交換器)

連接器 Connector	:	UTP
介面 Interface	:	Ethernet

PI 緊急通話器介面 (經由網路交換器)

連接器 Connector	:	UTP
介面 Interface	:	Ethernet

TETRA 無線電車機介面

連接器 Connector	:	UTP
介面		

	Data Interface	:	RS232
	語音介面	:	
	Audio Interface	:	600 歐姆平衡式
TRCP	無線電控制面板介面		
	連接器 Connector	:	UTP
	資料介面	:	
	Data Interface	:	RS485
	語音介面	:	
	Audio Interface	:	600 歐姆平衡式
TRIU	前後無線電介面單元		
	連接器 Connector	:	UTP
	資料介面	:	
	Data Interface	:	RS485
	語音介面	:	
	Audio Interface	:	600 歐姆平衡式

### 4.3.3 設備說明 EQUIPMENT DESCRIPTION

TETRA 無線電介面單元包括以下模組：

The TETRA Radio Interface Unit comprises the following modules:

#### 4.3.3.1 電源模組 POWER MODULE

TRIU 配置兩台直流電源的電源供應器、其接受來自列車所提供的 110V DC 的電力、分別轉換為 12V 直流電以及 48V 直流電、其中 48V 直流電源供應給在 TRIU 內部的廣播放大器使用、12V 直流電源除了供應 TRIU 本機所需電力外並將供電給無線電控制面板以及 TETRA 無線電車機運作。

There are 2 sets of DC/DC power supply installed within TRIU. The power supply received the DC110V power from the train set then convert to DC12V and DC48V. The DC48V will provide the power for the PA Amplifier which installed in the TRIU. The DC12V is not only provide the power for TRIU and also for both the TETRA Radio Control Panel and TETRA Mobile Unit.

Power Module	
Connector	UTP-4 Pin-M*1 (TIU-1)
	UTP-4 Pin-F*1 (TIU-2)

<b>Input Voltages</b>	110Vdc(66~154V)
<b>Output Voltages</b>	48VDC/ 100W 12VDC/ 250W
<b>Switching Frequency</b>	55kHz +/- 3kHz

#### 4.3.3.2 音訊通道控制器 **AUDIO SWITCH CONTROL**

音訊通道控制器是由語音輸出入介面, 語音訊號的放大, 隔離變壓器, 語音閘道器, 微處理器所組成。

The Audio Switch Control consists of the audio I/O interface, power amplification of PA audio, isolation transformer, audio gateway, microprocessor.

<b>Audio Switch</b>	
<b>Connector</b>	UTP-35 Pin-F*1 (TIU-3)
<b>Microcontroller Unit</b>	MPC89x515A
<b>Power Supply</b>	DC12V
<b>Audio Gateway</b>	8 CH Audio I/O
<b>Control Interface</b>	RS-232

#### 4.3.3.3 功率放大器 **POWER AMPLIFIER**

功率放大器是從音訊通道控制器接收到語音訊號後放大再將訊號傳送之喇叭播放。連接系統架構圖如圖 4-1 所示。

The Power Amplifier consists of the audio from Audio Switch Control and composite audio output to speaker in the train. The Connection Architecture is as Figure 4-1.



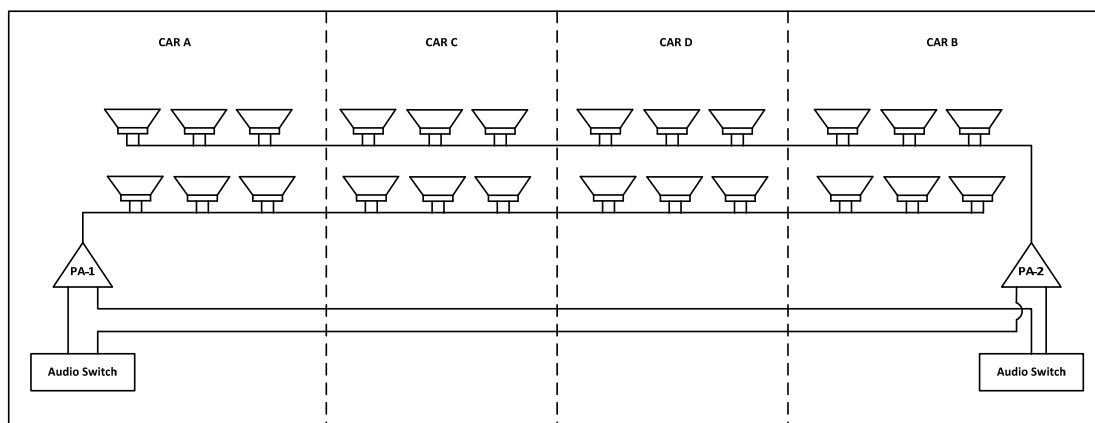


圖 4-1 功率放大器驅動喇叭配置方塊圖

Figure 4-1- Block diagram of the location of Power amplifier drive speaker

功率放大器規格資料如下所示：

The Power amplifier specification data as follow:

Power Amplifier	
Connector	UTP-4 Pin-F*1 (TIU-4)
Power Supply	DC48V
Output Voltage	16VAC 8Ω
Output Power	30W
Frequency Response	20Hz~20KHz
Signal-to-Noise Ratio	>50 dB
Transformers	Input Impedance: 40W(250Ω )/100V Output Impedance: 8Ω

#### 4.3.3.4 控制單元 CONTROL UNIT

控制單元為 TRIU 的核心，其功能包含：接收(TROU 及 TRCP)控制信號、切換語音路徑、預錄廣播發送、PI 封包轉換、發送 PIDS。並提供介面與列車控制器作資料交換並接收列車控制器所傳送的控制信號、設備狀態以及列車狀態資訊。

The Control Unit is kernel of the TRIU. Include: receiving TROU & TRCP control signal, switch audio path, deliver pre-recorded broadcast, convert PI package and deliver PIDS information. And provide Interface for exchange data, equipment status and train information with car controller.

<b>Control Unit</b>	
<b>Connector</b>	UTP-19Pin-F*1 (TIU-5) UTP-12Pin-F*1 (TIU-6)
<b>Processor System</b>	INTEL Atom D510 1.66GHz
<b>Power Supply</b>	DC12V
<b>Internal I/O</b>	RS232*2 RS422/RS485*2 Ethernet*3
<b>Operating System</b>	Windows 7 Embedded 32bit Standard Edition

#### 4.3.3.5 旅客對講機混音器 PI MIXER

旅客對講機混音器提供 TRIU 與 PI 間的音訊數位/類比轉換，並提供兩支 PI 同時混音之功能。

PI Mixer provides TRIU between the PI audio digital / analog converter, and provides two PI while Remix function.

<b>PI Mixer</b>	
<b>Connector</b>	UTP-8 Pin-F*1 (TIU-7)
<b>Power Supply</b>	DC12V
<b>Interface</b>	Ethernet (Audio Visual Bridging, AVB)
<b>Mixer</b>	2CH Remix

#### 4.3.4 模組方塊圖 BLOCK DIAGRAM

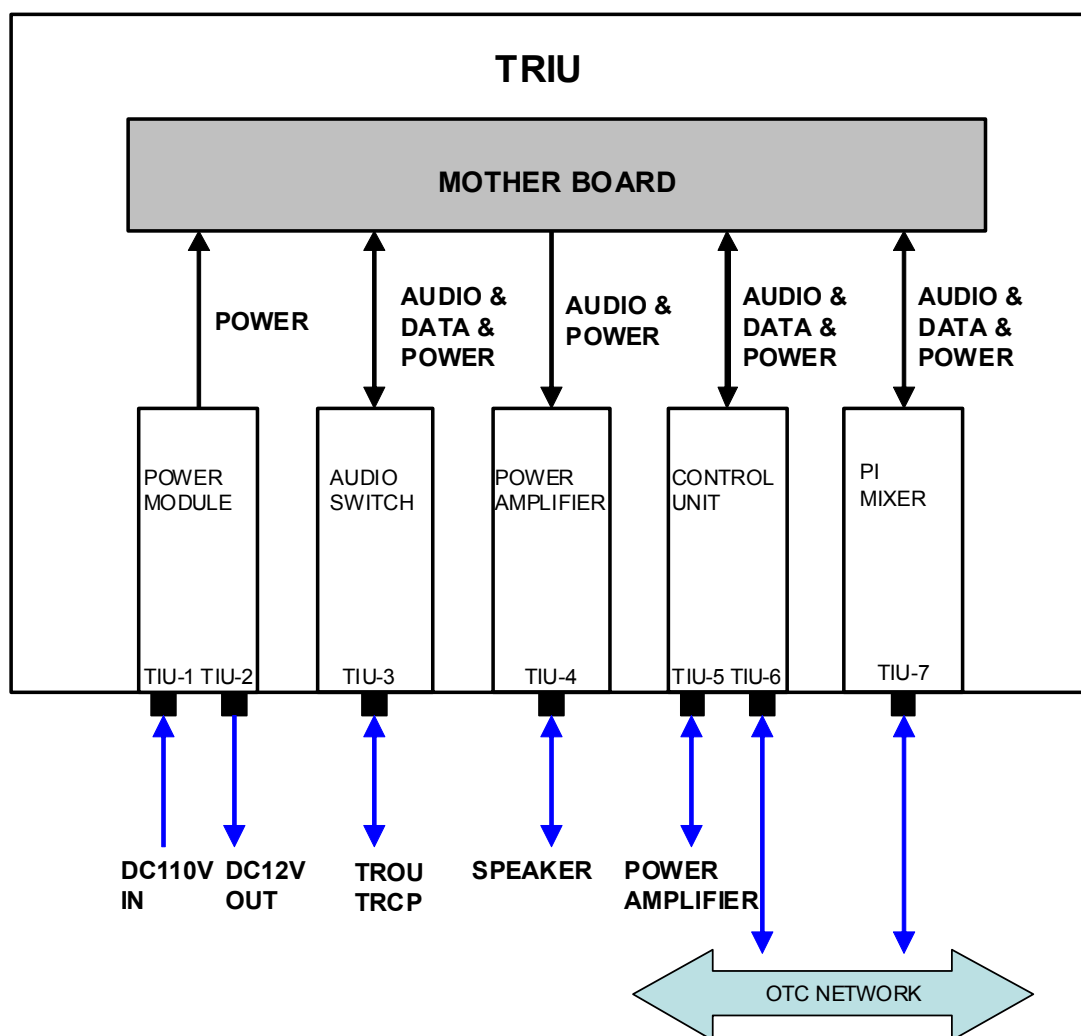


圖 4-2 列車無線電介面單元方塊圖  
Figure 4-2 – Block diagram of the TRIU

#### 4.4 列車無線電控制平台和服務對講機 TETRA RADIO CONTROL PANEL(TRCP) AND SERVICE INTERCOM(SI)



##### 4.4.1 設備說明 EQUIPMENT INTRODUCTION

這份文件是描述有關台北環狀線第一階段列車通訊系統之 TETRA 無線電控制平台的設備規格。TETRA 無線電控制平台支援以下功能：

This document describes the equipment specifications of the TETRA Radio Control Panel (TRCP) for Taipei Circular Line. The TRCP supports the following functions:

提供人機介面讓駕駛員於手動駕駛模式時能操作列車通訊系統中的通訊系統。

Provide human machine interface to for the operator to operate the Communication when manual mode driving.

提供控制及語音通道供 TETRA 無線電介面單元對車廂旅客做語音廣播用。

Provide the control & speech path to the TETRA Radio Interface Unit for the audio broadcasting to passenger saloon

提供與 TETRA 無線電車機的數據介面。

Provide data interface with TETRA Radio Onboard Unit Terminal

每一列車組前後車頭手動駕駛面板附近提供一組 TETRA 無線電控制平台。

One TRCP is provided to both end of the Train set around the manual driving panel.

#### 4.4.2 設備規格 EQUIPMENT SPECIFICATION

##### 4.4.2.1 電力規格 ELECTRICAL SPECIFICATION

輸入電壓 : 12VDC  
Input Voltages

##### 4.4.2.2 介面規格 INTERFACE SPECIFICATION

- 列車識別控制單元介面規格 TRIU Interface Specifications

連接器 Connector	UTP
---------------	-----

- (1) 語音訊號 : 行控中心及服務對講機的語音輸出  
Audio Signal : OCC and SI audio output

I/O 阻抗 I/O Impedance	變壓器阻抗, 600 歐姆 Isolated transformer input and output, 600 ohms
頻率響應 Frequency Response	300 - 3400 Hz
音頻輸出 Audio output	0dBm at 1KHz audio output.

- (2) 序列 I/O 控制訊號 : 列車識別控制單元控制訊號  
Serial I/O Control Signals : TRIU Control

Serial I/O for TRIU:	Half-duplex RS485
----------------------	-------------------

- TETRA 無線電介面規格 TETRA Mobile Radio Interface Specifications

- (a) 連接器 Connector : UTP  
(b) 序列 I/O 訊號給 TETRA 無線電 : RS232  
Serial I/O for TETRA Radio

- 服務對講機介面規格 Service Intercom Interface Specifications

- (1) 語音訊號 : 行控中心的語音輸出  
Audio Signal : OCC and SI audio output

(a)連接器 Connector	UTP
(b) I/O 阻抗 I/O Impedance	變壓器阻抗, 600 歐姆 Isolated transformer input and output, 600 ohms
(c)頻率響應 Frequency Response	300 - 3400 Hz
(d)音頻輸出 Audio output	0dBm at 1KHz audio output.

#### 4.4.3 設備模組 **EQUIPMENT MODULE DESCRIPTION**

TETRA 無線電控制平台包括以下的功能模組。

The TRCP comprises the following functional modules.

##### 4.4.3.1 控制電路板 **TRCP CONTROL BOARD**

控制電路板功能包括利用微處理器控制(1)命令和控制 TETRA 無線電介面單元(2)控制及操作列車通訊系統。

TRCP Control Board controls functions including using by Micro-processor signal controlling for(1) commanding and controlling together with TRIU, (2) controlling the operation flow for train Communication System.

##### 4.4.3.2 功能按鍵 **TRCP KEY BUTTONS**

TETRA 無線電控制平台提供以下幾個按鍵

(1) 主控 (2) 車內廣播 (3) 確認 (4) 行控 (5) 旅客對講 (6) 主線 (7) 直通模式 (8) 機廠 (9) 旅客對講主控(10) 備用 1 (11) 備用 2 (12) 備用 3 (13) 備用 4。

The TRCP provides the buttons for the TRCP. The key buttons are

(1) Master (2) Local PA (3) Enter (4) OCC (5) PI (6) Main Line (7) DMO (8) Depot (9) PI Master (10) S1 (11) S2 (12) S3 (13) S4.



#### 4.4.4 方塊圖 BLOCK DIAGRAM

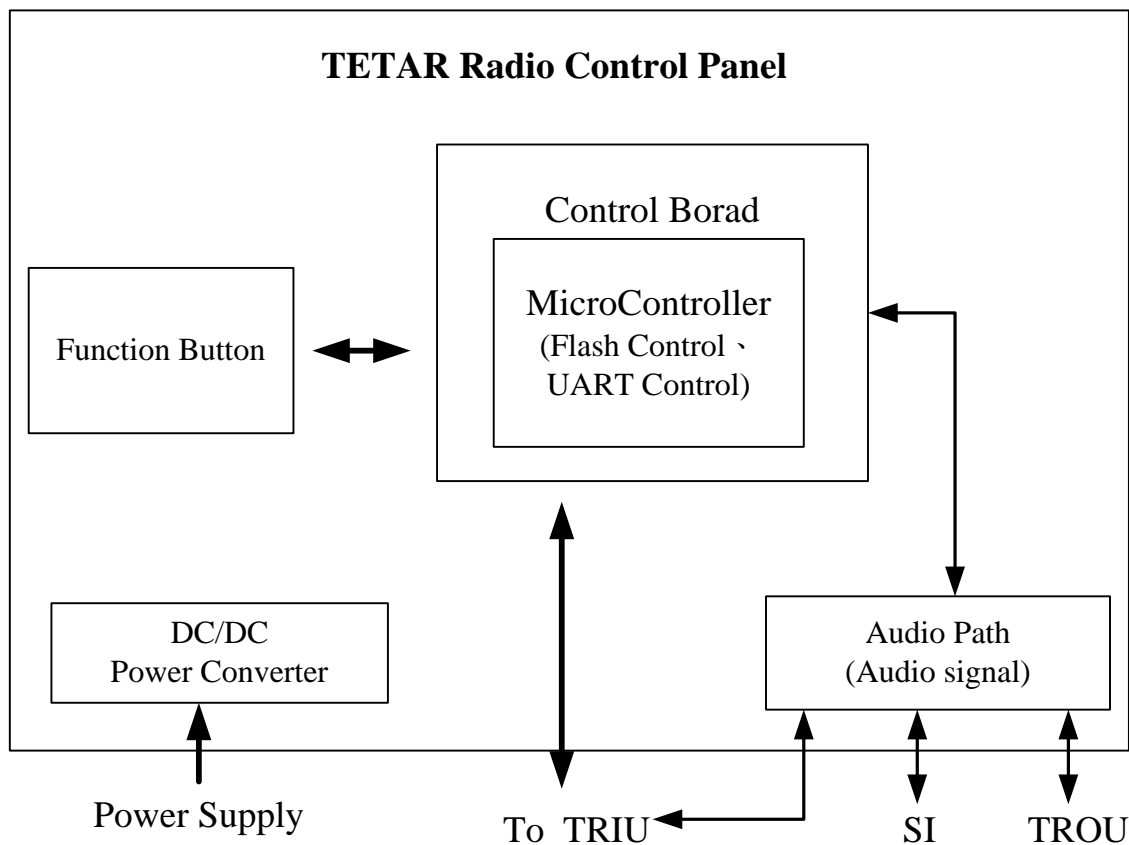


圖 4-3- 列車無線電控制面板方塊圖  
Figure 4-3 - Block diagram of TRCP

## 4.5 旅客緊急對講機 PASSENGER INTERCOM (PI)



### 4.5.1 設備說明 EQUIPMENT INTRODUCTION

它提供以下的功能：

The Passenger Emergency Intercom supports the following functions:

本設備提供旅客在緊急狀態期間所使用。

The device provides help request facility for passengers during emergency.

本設備提供旅客與行車控制中心人員（或駕駛員）在緊急狀態下的語音通訊。

The device provides audio communication between passengers and operators in the OCC (or Train Operator) during the emergency situation.

每一車廂將提供 3 組旅客緊急對講機。

There are three PIs in each car.

### 4.5.2 設備規格 EQUIPMENT SPECIFICATION

#### 4.5.2.1 電力規格 ELECTRICAL SPECIFICATION

輸入電壓 Input Voltage	PoE ( Power Over Ethernet ) 48V From PoE Switch provide
-----------------------	--

#### 4.5.2.2 介面規格 INTERFACE SPECIFICATION

與 PoE 交換器設備的語音傳送與接收介面

Transmitting and Receiving Audio data from the PoE Switch equipment interface:

連接器 Connector	UTP
介面 Interface	乙太網路 Ethernet
紅色按鈕 Red Pushbutton (內嵌 LED)	單刀單閘 SPST, IP65 (LED embedded in the button)

#### 4.5.3 模組方塊圖 BLOCK DIAGRAM

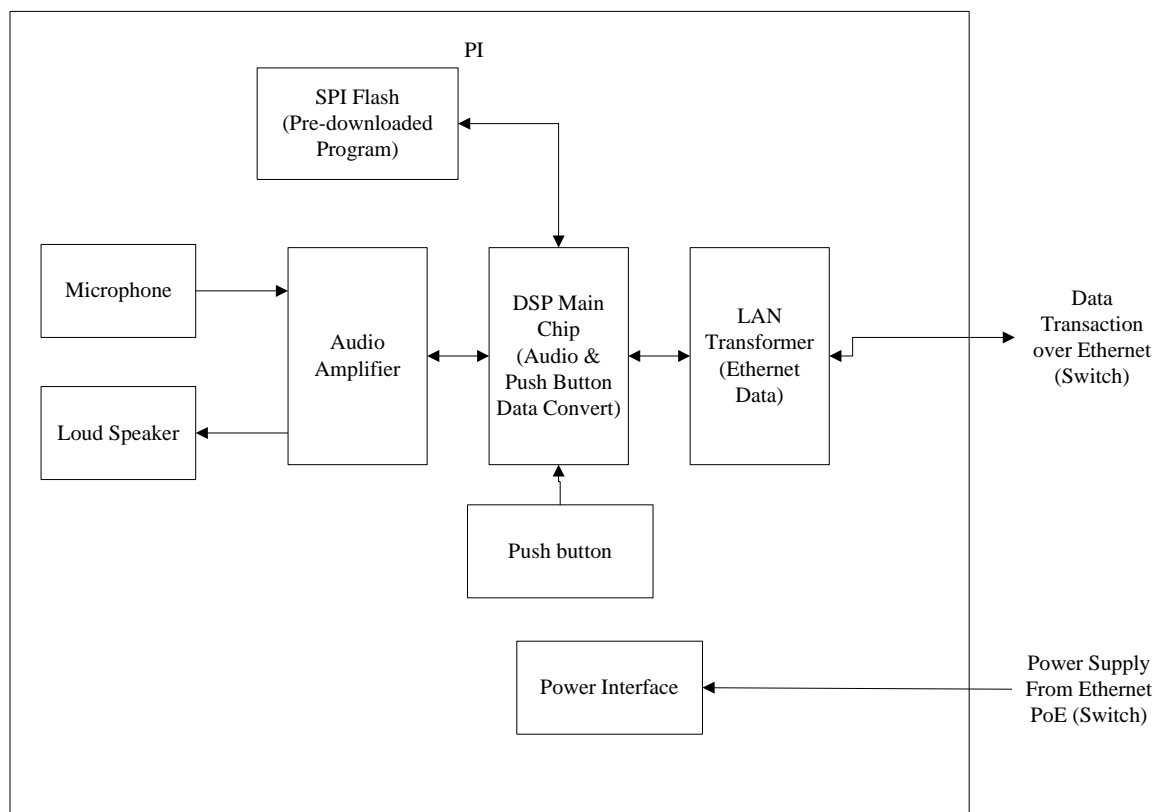
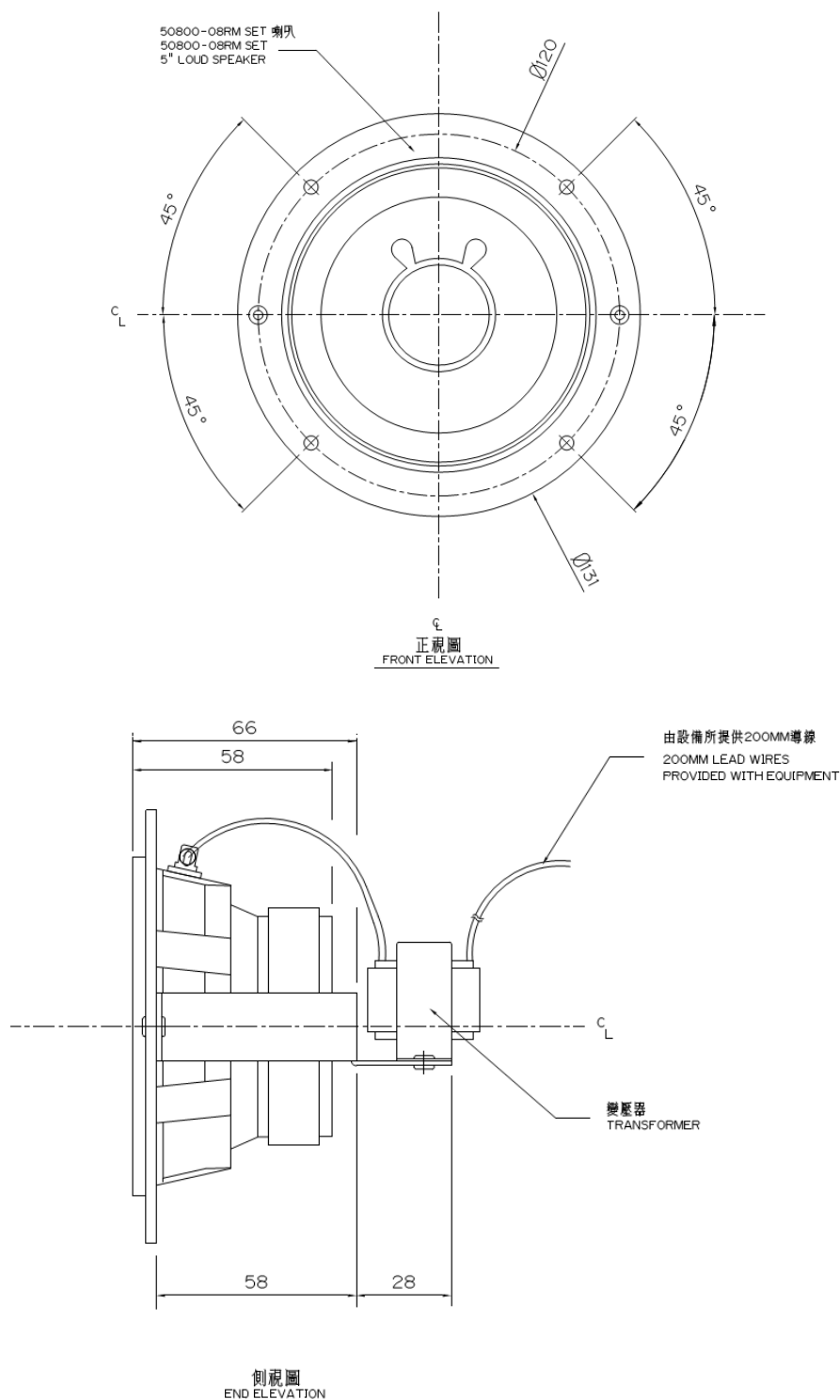


圖 4-4 緊急通話器方塊圖  
Figure 4-4 Block diagram of the PI

## 4.6 廣播喇叭 PA SPEAKER



### 4.6.1 設備說明 EQUIPMENT INTRODUCTION

列車通訊系統所使用的喇叭，其型號為音瀚 50800-08RM。廣播目的是為能在列車環境中，提供清晰的廣播品質。

In Hann 50800-08RM Speaker is used in the on-train communication system. The audio quality is clear for audio broadcast purpose in the on-train environment.

#### 4.6.2 設備規格 EQUIPMENT SPECIFICATION

50800-08RM 喇叭規格說明如下所示：

The specification of the 50800-08RM speaker is as follows:

外徑 Outer Dimensions	131 mm
功率 Rated (Max.) Input	15 W (25W )
阻抗 Voice Coil Imp.	$8 \pm 1.2 \Omega$ (450Hz 1 V )
最低共振頻率 ( fo ) Lowest Resonance Frequency	$150 \pm 30 \text{ Hz}$ ( 1 V )
音壓 Sound Pressure Level	$98 \pm 2 \text{ dB}$ ( 1 w 0.5 m )
偏差率 Frequency Response Deviation	25 dB max. ( fo 20 K Hz )
磁束密度 Flux Density	$1111 \pm 10 \%$ Gauss
淨重 Weight	523 g
磁鐵 Magnet	正磁: 70*32*15 mm ( oz ) 反磁: mm (oz )
常溫壽命 Room temperature Life	15 W 96 Hours
耐熱性 Heat Resistance	$70 \pm 2 ^\circ \text{C}$ 9 6 Hours 20 ~ 50 % RH
耐濕性 Humidity Resistance	$40 \pm 2 ^\circ \text{C}$ 9 6 Hours 90 ~ 95 % RH
耐寒性 Cold Resistance	$-20 \pm 2 ^\circ \text{C}$ 9 6 Hours

## 4.7 網路交換器 ETHERNET SWITCH



### 4.7.1 設備說明 EQUIPMENT INTRODUCTION

它提供以下的功能：

The Ethernet switch supports the following functions:

本設備提供列車上 OTC 設備的乙太網路介面。

The device provides Ethernet interface for network communication for all OTC equipment.

本設備提供 POE 電源給 IP 網路攝影機以及 PI 設備。

The device provides POE power for IP camera and PI equipment.

每一車廂將提供網路交換器。

There are one Ethernet switch will be provided in each car.

### 4.7.2 設備規格 EQUIPMENT SPECIFICATION

#### 4.7.2.1 電力規格 ELECTRICAL SPECIFICATION

輸入電壓 Input Voltage	48VDC
--------------------	-------

#### 4.7.2.2 介面規格 INTERFACE SPECIFICATION

網路交換器設備的網路和電源介面

Ethernet Switch equipment interface of Ethernet and Power

連接器 Connector :	M12
腳數 Pin Number :	4 pin and 8 pin
介面 Interface :	8 x 快速乙太網路 2 x 超高速乙太網路
	8 x Fast Ethernet 2 x Gigabit Ethernet

連接器 Connector :	M23
腳數 Pin Number :	6 pin
介面 Interface :	電源 Power



## 4.8 電源供應器 POWER SUPPLY



### 4.8.1 設備說明 EQUIPMENT INTRODUCTION

它提供以下的功能:The Ethernet switch supports the following functions:

OTC 設備將提供兩種電源供應器分別為

1. 110VDC 轉 48VDC 和 24VDC 的 150W 電源供應器，其中提供給 N-port 電壓 24VDC 和網路交換器電壓 DC48V

2. 110VDC 轉 48VDC 的 100W 電源供應器，其中供應給網路交換器電壓 48VDC

OTC equipment will provide two kinds of Power supply

1. 150W power supply convert 110VDC to 48VDC and 24VDC. 24VDC provides to N-port and 48VDC provides to Ethernet switch.

2. 100W power supply convert 110VDC to 48VDC. 48VDC provides to Ethernet switch.

### 4.8.2 設備規格 EQUIPMENT SPECIFICATION

#### 4.8.2.1 電力規格 ELECTRICAL SPECIFICATION

輸入電壓 Input Voltage :	110VDC
輸出電壓 Output Voltage :	48VDC , 24VDC

輸入電壓 Input Voltage :	110VDC
輸出電壓 Output Voltage :	24VDC

#### 4.8.2.2 介面規格 INTERFACE SPECIFICATION

電源供應器的介面 The interface of Power

連接器 Connector :	電源端子 Terminal block
腳數 Pin Number :	5 pin

## 5 系統介面 SYSTEM INTERFACE

以下將標列列車通訊系統各設備介面以提供給介面控制文件來管控。

Each of On Train Communication System equipments interfaces will be listed as below for interface control document use.

### 5.1 列車通訊子系統系統設備介面 ON-TRAIN COMMUNICATION SUBSYSTEM INTERFACE TABLE

OTC 設備系統與其他系統通訊介面的設計如下表。

The following table is the design of communication interface between OTC system and other system.

表 5-1：OTC 設備系統與其他系統通訊介面列表

Table 5-1 : Communication interface between OTC system and other system list

OTC 系統設備 OTC system equipment	系統介面的設備 Equipment of Interface system	設備介面系統 Equipment Interface system	通訊介面 Communicati on Interface
TRIU	DCS 網路交換器 DCS Ethernet Switch	數據通訊系統 DCS	乙太網路 Ethernet
OTC 網路交換器 OTC Ethernet Switch	IP 網路攝影機 IP camera	閉路電視系統 CCTV system	乙太網路 Ethernet
OTC 網路交換器 OTC Ethernet Switch	數位影像錄影機 DVR	閉路電視系統 CCTV system	乙太網路 Ethernet
OTC 網路交換器 OTC Ethernet Switch	N-port	列車旅客資訊顯示器 系統 Onboard PID system	乙太網路 Ethernet
TETRA 無線電車機 TROU	TETRA 基地台 TETRA Base station	數位無線電系統 Digital Radio System	TETRA 無線電 TETRA radio

### 5.2 網路需求 NETWORK REQUIREMENT

OTC 網路交換器的埠數使用需求如下列表

The following table is the requirement of OTC Ethernet switch ports.

表 5-2：OTC 網路交換器的埠數使用需求列表

Table 5-2 : The requirement of OTC Ethernet switch ports list

系統 System	設備名稱 Equipment name	Car A	Car C	Car D	Car B
OTC	TETRA 無線電介面單元 TRIU	3	-	-	3
OTC	乘客對講機 PI	4	2	2	4
OTC	網路交換器 到網路交換 器	2	2	2	2

系統 System	設備名稱 Equipment name	Car A	Car C	Car D	Car B
	Ethernet Switch to Ethernet switch				
CCTV	數位影像錄影機 DVR	1	-	-	1
CCTV	IP 網路攝影機 IP camera	2	2	2	2
PIDS	N-port	1	1	1	1
OTC	維修阜 Maintenance port	1	-	-	1

OTC 系統對於 DCS 網路交換器初步的使用埠數需求如下列表

The following table is OTC system ports requirement on DCS Ethernet switch.

表 5-3：OTC 網路交換器的埠數使用需求列表

Table 5-3：OTC system ports requirement on DCS Ethernet switch

系統 System	設備名稱 Equipment name	Car A	Car C	Car D	Car B
OTC	TETRA 無線電介面單元 TRIUI	1	-	-	1
CCTV	數位影像錄影機 DVR	1	-	-	1

### 5.3 列車通訊系統 TETRA 無線電通訊使用需求 ONBOARD TETRA RADIO COMMUNICATION REQUIREMENT

列車通訊系統 TETRA 無線電通訊使用需求如下列表

The following table is the onboard TRTRA radio requirement for OTC system.

表 5-4：列車通訊系統 TETRA 無線電通訊使用需求列表

Table 5-4：The onboard TRTRA radio requirement for OTC system list

列車通訊功能 OTC function	TETRA 無線電通話模式 TETRA radio communication type	通話型式 Type of call	槽 Slot
PI 對 OCC 語音通訊 PI voice communication with OCC	個別通話 Individual call	全雙工 Full duplex	1
OCC 對 PI 監聽 OCC audio monitor from PI	個別通話 Individual call	半雙工 Half duplex	1

列車通訊功能 OTC function	TETRA 無線電通話模式 TETRA radio communication type	通話型式 Type of call	槽 Slot
SI 對 OCC 語音通訊 SI voice communication with OCC	群組通話 (主線通話群組) Group call (Main Line talk group)	半雙工 Half duplex	1
SI 對機場調度員語音通訊 SI voice communication with Depot Operator	群組通話 (機場通話群組) Group call (Depot talk group)	半雙工 Half duplex	1
OCC 對列車廣播 On train public address from OCC	群組通話(動態群組號碼配置) Group call(Dynamic Group Number Assignment )	半雙工 Half duplex	1
行控中心發送文字訊息於列車 OCC send text message to train	短數據服務 Short Data Service		1
OTC 設備狀態和告警訊息傳送到 OCC OTC equipment status and alarm to OCC	短數據服務 Short Data Service		1

#### 5.4 列車通訊系統的電源需求 THE POWER REQUIREMENT FOR OTC SYSTEM

列車將提供 OTC 系統 DC 110V 電源。實際上，OTC 系統由列車的電池充電器來供應電源，因此，電源複置的功能與電池充電器一致。每車廂均有一具電池充電器，且整列車的四具電池充電器為併聯組態。即使一列車的兩具充電器故障，OTC 系統的功能將不受影響。有關列車電源供應細節請參閱推進與輔助電力系統。

Train will provide power supply for OTC system with DC 110V. To be clearer, OTC system is powered by battery charger and power redundancy is provided in accordance to the battery charger redundancy. There is 1 battery charger per each car and all these 4 battery chargers are in parallel configuration. Even 2 of 4 battery chargers are in failure, all the OTC system function will be guaranteed. Please refer to Propulsion and Auxiliary Power System for the details.

TRIUM 內部將有 DC110V 轉 DC12V 的電源供應器模組和 DC110V 轉 DC48V 的電源供應器模組，DC12V 將提供給 TRIUM 內部使用外還提供給 TRCP 以及 TROU，另外 DC48V 將提供給 PA Amplifier 使用。

TRIUM have modules of DC110V to DC12V power supply and DC110V to DC48V power supply. DC 12V will provide power for the TRIUM internal use and TRCP, TROU and DC48V will provide power for the PA Amplifier in the TRIUM.

請注意在緊急模式(無第三軌高電壓電力)，全部列車 PID 將會關閉，詳細請參考 TC1-D2022 電聯車-概念設計-推進與輔助電力系統。

Please note that in Emergency Mode (lack of third rail high voltage power) all the on board PID will be switched off. Please refer to TC1-D2022 EMU Propulsion and Auxiliary Power System for the details.

另外各車廂將提供 DC110V 轉 DC48V 電源供應器，提供電源給網路交換器和 N-port 電源。而 PI 和 IP 網路攝影機將由網路交換器以 POE 方式提供電源。OTC 設備的電源消耗需求請參考如下列表

The DC110V to DC48V power supply will provide power to the Ethernet switch and N-port in each car. PI and IP camera will use POE and be powered by Ethernet switch. Please refer to the Power Consumption of each OTC equipment as below.

表 5-5：OTC 設備的電源消耗需求  
 Table 5-5：The Power Consumption of each OTC equipment

列車設備 OTC Equipment	各設備電源消耗(W) Power Consumption each item(W)	數量 Quantity	設備總電源消耗(W) Equipment total Power Consumption (W)
TETRA 天線 TETRA Antenna	N/A		
TETRA 無線電控制平台 TRCP	From TRIU		
無線電車機 TROU	From TRIU		
無線電介面單元 TRIU	420	2	840
列車數位錄影機 DVR	100	2	200
旅客資訊顯示器 PIDS	100	24	2400
喇叭 Speaker	N/A		
乘客對講機 PI	From Ethernet Switch		
IP 攝影機 IP Camera	From Ethernet Switch		
網路交換器 Ethernet Switch	From Power Supply		

N-port	From Power Supply		
DC48V/24V 電源供應器 DC48V/24V Power Supply	150	4	600
DC48V 電源供應器 DC48V Power Supply	100	2	200
一列車總消耗電源功率(W) Power Consumption for One Train			4240



## 5.5 列車通訊系統設備內部介面 **OTC SYSTEM EQUIPMENT INTERNAL INTERFACES**

表 5-6：無線電介面單元介面

Table 5-6 : Internal interface of On Train Communication System

TETRA 無線電界面單元 TRIU interface	
接收介面 Input Interface	列車控制器經由 M12 乙太網路接口傳送之告警與事件 CC send alarm and event via M12 Ethernet Port
輸出介面類型 Output Interface Type	<ul style="list-style-type: none"> <li>PI 與 N-port 功能運作經由 Ethernet, M12 介面 PI and N-port operation function via Ethernet, M12 interface</li> <li>N-port 功能運作與 PID 設備經由 EIA-485, M12 介面 N-port and PID operation function via Ethernet, M12 interface</li> <li>TRCP 與 TROU 功能運作經由 EIA-422/232, M12 介面 TRCP and TROU operation via EIA-422/232 M12 Interface</li> <li>語音介面，600 歐姆-平衡式 Audio Interface, 600 ohm unbalance</li> </ul>
間接對應（經由 TETRA server） Direct Correspondence (via TETRA server)	<ul style="list-style-type: none"> <li>與 CMFT 伺服器的 介接並接受控制指令，資料 以及語音資料。 Interface with CMFT server and receive the control command, data and audio information</li> </ul>

表 5-7：TETRA 無線電車機介面

Table 5-7 : TETRA Mobile Unit interface

TETRA 無線電車機介面 TROU Interface	
接收介面 input interface	<ul style="list-style-type: none"> <li>控制訊號與資料經由 PEI Control command and data via PEI</li> <li>語音訊息 Audio message</li> </ul>
輸出介面 output interface	<ul style="list-style-type: none"> <li>控制訊號與資料經由 PEI Control command and data via PEI</li> <li>語音訊息 Audio message</li> </ul>
直接對應 Direct Correspondence	<ul style="list-style-type: none"> <li>TETRA 無線電系統 TETRA Radio System</li> </ul>
間接對應 Indirect Correspondence	N/A

表 5-8：列車無線電控制面板介面

Table 5-8 : Train Radio Control Panel interface

TETRA 無線電控制面板介面 TRCP Interface	
接收介面 function interface	<ul style="list-style-type: none"> <li>控制訊號與資料經由 EIA –RS422/232 Control command and data via EIA-RS422/232</li> <li>語音介面，600 歐姆-平衡式 Audio Interface, 600 ohm unbalance</li> </ul>
直接對應 Direct Correspondence	<ul style="list-style-type: none"> <li>控制訊號與資料經由 EIA –RS422/232 Control command and data via EIA-RS422/232</li> <li>語音介面，600 歐姆-平衡式 Audio Interface, 600 ohm unbalance</li> </ul>
間接對應 Indirect Correspondence	N/A

## 6 告警與監視 **ALARM AND MONITORING**

列車通訊系統 OTC 的故障告警及狀態監視訊息，是由 TRIU 收集之後經由 TETRA 無線電以簡訊模式回傳 OCC。

The fault information and status information of OTC in a car are collected by the TRIU in that car and passed back to OCC through the TETRA Radio in that car by the SDS.

TRIU 會定時對列車通訊系統所屬設備進行狀態查詢，並回報控制中心設備狀態和設備資訊，如以下列表：

The TRIU will poll the on train communication system equipment for the equipment status and record in the TRIU. The equipment status will be send back to the OCC .The equipment alarms and information are stated as follows:

表 6-1：OTC 設備告警列表

Table 6-1：OTC Equipment Alarm list

OTC 設備告警列表 Equipment Alarm list	
1	TRIU 與 TRCP 連接狀態 TRIU and TRCP connection status
2	TRIU 與 PI 連接狀態 TRIU and PI connection status
3	TRIU 與 PID 連接狀態 TRIU and PID connection status
4	TRIU 與 N-port 連接狀態 TRIU and N-port connection status
5	TRIU 與 網路交換器連接狀態 TRIU and Ethernet Switch connection status
6	TRIU 與 TROU 連接狀態 TRIU and TROU connection status
7	TRIU 與 OCC 連接狀態 TRIU and OCC connection status
8	TRIU 與 CC 連接狀態 TRIU and CC connection status
9	主控端 TRIU 與副控端 TRIU 狀態 Master and Slave TRIU status

表 6-2：OTC 設備資訊列表

Table 6-2：OTC Equipment information list

OTC 設備資訊列表 OTC Equipment information list	
1	列車號碼 Train ID
2	TRIU 軟體版本 TRIU Software version
3	列車預錄文字版本 On train pre-defined text message version
4	列車預錄廣播版本 On train pre-defined audio message version

## 7 系統備援 SYSTEM REDUNDANCY

本列車通訊系統在同一列車兩端各配置安裝一台 TETRA 無線電介面單元 TRIU，在列車正常運行時，一端將設定為主控，而另一端則為副控，主控模式端的 TRIU 會負責對於列車通訊系統的運作操控，並對列車控制器 CC 做資料交換以及回報控制中心或接受控制中心下傳指令執行工作，若當主控端的 TRIU 故障時，將由副控端 TRIU 接手轉為主控模式負責對於列車通訊系統的運作操控，並對列車控制器 CC 做資料交換以及回報控制中心或接受控制中心下傳指令執行工作。

Both end of the Train will be installed one TRIU. During the normal train operation one TRIU will be the master and the other one will be the slave. Only the master TRIU could be in charge of the control of all the on train communication system equipment, interface with CC for the data exchange and receive the command from the OCC for the equipment function execution. The slave mode TRIU will monitor the status of the master TRIU and will take the master control when the master TRIU malfunction automatically.

當列車通訊設備通電開啟時，一開始 A 車的 TRIU 會自動設置為主控而 B 車的 TRIU 為副控，另外 TRIU 也可以透過 TRCP 手動設定為主控模式。

當發生以下狀況時，主控端的 TRIU 將會自動切換至副控端 TRIU：

- 假設主控端的 TRIU 在 A 車，當發生以下狀況主控端將會切換到 B 車的 TRIU

1. 主控端的 TRIU 發生故障
2. A 車的網路交換器發生故障
3. A 車的 TROU 發生故障
4. A 車的 TRCP 發生故障
5. 主控端的 TRIU 無發接收 CC 的訊號

- 假設主控端的 TRIU 在 B 車，當發生以下狀況主控端將會自動切換到 A 車的 TRIU

1. 主控端的 TRIU 發生故障
2. B 車的網路交換器發生故障
3. B 車的 TROU 發生故障
4. B 車的 TRCP 發生故障
5. 主控端的 TRIU 無法接收到 CC 的訊號

When communication equipment power on, at the beginning TRIU in A car will configure to be master and TRIU in B-car will configure to be slave. TRIU also can configure to be master mode manually via TRCP.

In following condition, Master TRIU will change to Slave TRIU automatically:

- If Master TRIU is in A car, Master TRIU will change from A car to B car in following status

1. Master TRIU fails
  2. A car Ethernet Switch fails
  3. A car TROU fails
  4. A car TRCP fails
  5. Master TRIU cannot receive the information from CC
- If Master TRIU is in B car, Master TRIU will change from B car to A car automatically in following status:
1. Master TRIU fails
  2. B car Ethernet Switch fails
  3. B car TROU fails
  4. B car TRCP fails
  5. Master TRIU cannot receive the information from CC

## 8 時鐘同步 TIME SYNCHRONIZATION

OTC 系統如 TRIU 等電腦設備採取 NTP 網路校時方式，經由車上網路交換器和車上 CCTV 系統的 DVR 伺服器取得時間資訊來完成時間同步。詳細請參考 TC1-69201 – 閉路電視系統 – 細部設計文件相關章節。

The OTC system such as TRIU which is computer based equipments uses NTP for time synchronization. It obtains the time information and synchronizes with onboard DVR of CCTV system. Detailed information, please refer to TC1-69201 - Closed Circuit TV - Detailed Design.

## 9 列車未來擴充性 OTC SYSTEM FUTURE EXPANDABILITY

- (1) OTC 系統主要採標準之乙太網路架構與車上其他系統連接，而設備相互溝通也是用標準之 TCP/IP 傳輸層通信協定，如以後要擴充其他列車通訊設備只需要擴充乙太網路的連接埠和使用相同的 TCP/IP 傳輸層通信協定，即可以和車上其他系統網路通訊。
- (1) OTC system mainly adopts the standard of Ethernet network architecture to connect with other onboard system and also uses the standard of TCP/IP transmission layer communication protocol to communicate with each other. If there has to expand the other onboard communication equipment in the future. It only needs to expand the Ethernet network port and uses same TCP/IP transmission layer communication protocol that can communicate with other onboard subsystem.
- (2) 而其他不經由乙太網路傳輸的也將採用標準之 RS485, RS422 或 RS232 等協定，做為設備之間的溝通，以利未來設備擴充。
- (2) Besides Ethernet network transmission, other communication protocol will also use standard protocol such as RS485, RS422 and RS232 to communicate with each onboard equipment for future expandability.
- (3) 在無線電方面，列車通訊系統提供之無線電車機將符合 TETRA 無線電標準之規範，以利未來設備擴充。
- (3) In regard to Radio system, OTC will provide the TETRA Radio Onboard Unit that complies to TETRA Radio standard for future expandability.
- (4) 硬體設備增加，對軟體無重大影響，故未來擴充無須更動軟體。
- (4) Hardware increases, no significant impact on the software, so no need to change the software for future expansion.

## 10 設備與纜線編碼 EQUIPMENT AND CABLE CODING

下文將說明代碼所代表時鐘系統之規則。

The rule of ID codes for representing Clock System is shown as follows.

### 10.1 設備編碼 EQUIPMENT CODE

Area code			Part number				Series number			Position
1 <sup>st</sup> Digit	2 <sup>nd</sup> Digit	3 <sup>rd</sup> digit	PBS code	1 <sup>st</sup> Digit	2 <sup>nd</sup> Digit	3 <sup>rd</sup> digit	1 <sup>st</sup> Digit	2 <sup>nd</sup> Digit	3 <sup>rd</sup> digit	1 <sup>st</sup> Digit

- 區域代碼 Area code

Area code		
1 <sup>st</sup> Digit	2 <sup>nd</sup> Digit	3 <sup>rd</sup> Digit
X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>

位置代碼有三個欄位指示設備的位置，敘述如下：

Three boxes of area code identify the location of equipment as follows:

表 9-1：位置代碼對照表  
Table 9-1: Area code table

Area code 區域代碼			Location 位置	Remark 備註
1 <sup>st</sup> Digit	2 <sup>nd</sup> Digit	3 <sup>rd</sup> digit		
V	0	0	電聯車(概述) EMU (General)	
V	0	1	1 號電聯車 EMU No1	
V	0	2	2 號電聯車 EMU No2	
V	0	3	3 號電聯車 EMU No3	
V	0	4	4 號電聯車 EMU No4	
V	0	5	5 號電聯車 EMU No5	
V	0	6	6 號電聯車 EMU No6	
V	0	7	7 號電聯車 EMU No7	
V	0	8	8 號電聯車 EMU No8	
V	0	9	9 號電聯車 EMU No9	
V	1	0	10 號電聯車 EMU No10	
V	1	1	11 號電聯車 EMU No11	
V	1	2	12 號電聯車 EMU No12	
V	1	3	13 號電聯車 EMU No13	
V	1	4	14 號電聯車 EMU No14	
V	1	5	15 號電聯車 EMU No15	
V	1	6	16 號電聯車 EMU No16	



Area code 區域代碼			Location 位置	Remark 備註
1 <sup>st</sup> Digit	2 <sup>nd</sup> Digit	3 <sup>rd</sup> digit		
V	1	7	17 號電聯車 EMU No17	

● 產品編號 Part Number

Part Number			
PBS code	1st Digit	2nd Digit	3rd Digit
Y <sub>1</sub>	Y <sub>2</sub>	Y <sub>3</sub>	Y <sub>4</sub>

產品編號有四個欄位指示設備的種類，敘述如下：

Four boxes of Part Number identify the type of equipment as follows:

表 9-2：產品編號對照表  
Table 9-2: Part number table

Part Number 設備代碼				Equipment and/or location 設備 及/或 對應位置	Remark 備註
PBS code	1st Digit	2nd digit	3rd digit		
4  (“4”為通訊系統專用的代碼) Proprietary code of Communication System is “4”	T	I	U	TRIU	
	P	E	I	Passenger Intercom	
	S	I	E	Service Intercom	
	T	C	P	TRCP	
	T	O	U	TROU	
	P	I	D	PID	
	P	S	O	Power Supply	
	S	P	K	Speaker	
	M	S	W	Ethernet Switch	
	A	N	T	TETRA Antenna	

● 設備流水號 Equipment serial number

Serial number		
1st Digit	2nd Digit	3rd Digit
K <sub>1</sub>	K <sub>2</sub>	K <sub>3</sub>

三個欄位指示設備的流水號，依字母順序排序。

The three boxes show the equipment serial number in an alphabetical order.

● 位置 Position

Position
1 <sup>st</sup> Digit
J <sub>i</sub>

最後一個欄位指示設備的位置，依字母順序排序

The last one boxes show the equipment position in an alphabetical order.

例如：位於 A 車的 TRIU 的 ID 表示如下：

For example, the TRIU located in A car will be represented as follow:

Area code			Part number				Series number			Position			
1 <sup>st</sup> Digit	2 <sup>nd</sup> Digit	3 <sup>rd</sup> digit	PBS code	1 <sup>st</sup> Digit	2 <sup>nd</sup> Digit	3 <sup>rd</sup> digit	-	1 <sup>st</sup> Digit	2 <sup>nd</sup> Digit	3 <sup>rd</sup> digit	/	1 <sup>st</sup> Digit	
V	0	0	-	4	T	I	U		0	0	1	/	A

## **10.2 纜線標籤與編碼 CABLE MARKER AND NUMBERING**

有關列車纜線標籤與編碼，請參考列車送審文件 TC1-D3-415 細部設計 - 低壓電氣線路圖。

For vehicle cable marker and numbering, please refer to EMU documents TC1-D3-415 DDR - LV Electrical Schematic Diagram

## **11 列車通訊系統設備清單 ON TRAIN COMMUNICATION SYSTEM EQUIPMENT LIST**

以下章節將說明列車通訊系統設備安裝地點，包括說明型號和設備的數量,將用表格之方式列出。

The following sections summarize the equipment in the On Train Communication System in different location. The list table will include the description, the model and the quantity of the equipment.

CMFT 伺服器屬於「通訊系統多功能操作台」系統所提供，不在本文件提列。

The CMFT server provided by “Communication Multi-function Terminal” system, it will not be listed in this document.

列車通訊設備為安裝在列車上，本文件中所列設備位置與清單為單一系列車組 4 個車廂所安裝的數量。本合約為要提供 17 列列車組的列車通訊設備。

All the equipments of the On Train Communication System will be installed in the train. The below table for the equipment quantity and the location is the total quantity for one 4 cars train unit. The total quantity of the on train communication system equipment will be installed for 17 trains for the Taipei Circular Line Project.

## 11.1 每一列車通訊系統設備清單和位置 OTC SYSTEM EQUIPMENT DEPLOYMENT AND LOCATION OF ONE TRAIN

每一列車設備清單和位置 Equipment list and location for one train						
設備名稱 Equipment name	型號 Model	Car A	Car C	Car D	Car B	Total
TETRA 無線電介面單元 (包含廣播放大器 和 DC/DC 電源供應器) TRIUI (including PA Amplifier ,DC / DC Power supply)	UFO-Link-CL-TRIUI	1	-	-	1	2
TETRA 無線電控制平台 TRCP	UFO-Link-CL-TRCP	1	-	-	1	2
服務對講機 Service Intercom	UFO-Link-CL-SI	1			1	2
TETRA 天線 TETRA Antenna	LoPro NMO4020	1	-	-	1	2
廣播喇叭 PA Speaker	RA13EC070F01	6	6	6	6	24
TETRA 無線電車機 TROU	SRG3900	1	-	-	1	2
乘客對講機 Passenger Intercom	UFO-Link-CL-PI	3	3	3	3	12
網路交換器 Ethernet Switch	TN-5510-4PoE- 2GTXPB	2	1	1	2	6
DC48V/24V 電源供應器 DC48V/24V Power Supply	DCW152R- 110/4824FT-R7925	1	1	1	1	4
DC48V 電源供應器 DC48V Power Supply	DCW100R-110- 48FT-R7925	1			1	2

OTC 系統之纜線皆由電聯車系統提供，詳細纜線規格請參閱電聯車設計文件。

The cables of OTC system will be provided by EMU. Please refer to EMU design for cable specification.

關於列車 CCTV 設備清單請參閱文件 "TC1-69204 閉路電視系統 - 設備清單"。

For the On Train CCTV equipment list, please refer to the document "TC1-69204 Closed Circuit TV System - Equipment List"

關於列車 PID 設備清單請參閱文件 "TC1-D3601 - 細部設計 - 旅客資訊顯示系統"。

For the On Train PIDs equipment list, please refer to the document "TC1-D3601 - DDR PIDS"

## 11.2 列車通訊系統設備數量總表 OTC SYSTEM EQUIPMENT SUMMARY

設備名稱 Equipment name	17 Trains	備注 Remark
TETRA 無線電介面單元 (包含廣播放大器 和 DC/DC 電 源供應器 ) TRIU (including PA Amplifier DC / DC Power supply)	34	
TETRA 無線電控制平台 TRCP	34	
服務對講機 Service Intercom	34	(Part of TRCP)
TETRA 無線電車機 TROU	34	
TETRA 天線 TETRA Antenna	34	
廣播喇叭 PA Speaker	408	
乘客對講機 Passenger Intercom	204	
網路交換器 Ethernet Switch	102	
DC48V/24V 電源供應器 DC48V/24V Power Supply	68	DC/DC 供應電源給 N-port 和網路 交換器 DC/DC Power supply for N-port and Ethernet Switch
DC48V 電源供應器 DC48V Power Supply	34	DC/DC 供應電源給網路交換器 DC/DC Power supply for Ethernet Switch

備註:依照北市機系一所字第 10061125900 號變更設計，既而增加旅客緊急對講機 \*68 和網路交換器 \*34。

NOTES:According to SEMPO Letter ref #10061125900 add Passenger Intercom \*68 and Ethernet Switch \* 34.



## 12 設備規格 EQUIPMENT DATASHEETS

OTC 系統的主要設備規格如表所示:

The main equipment specifications of OTC system as table shown below:

表 1: 列車通訊系統的主要設備規格表

Table 1: Main Equipment Specification list of OTC system

設備 Equipment	設備型號 Equipment model	設備供應商 Equipment supplier	備註 Remark
TETRA 無線電車機 TROU	SRG3900	Sepura	附件二 APPENDIX 2
TETRA 天線 TETRA Antenna	LoPro NMO4020	Astron Wireless Technologies, Inc	附件三 APPENDIX 2
車廂廣播喇叭 PA Speaker	50800-08RM	音瀚實業有限公司 IN HANN INDUSTRIAL Corp.	附件四 APPENDIX 4
DC48V/24V 電源供應器 DC48V/24V Power Supply	DCW152R-110/4824FT-R7925	ABSOPLUSE	附件五 APPENDIX 5
DC48V 電源供應器 DC48V Power Supply	DCW100R-110-48FT-R7925	ABSOPLUSE	附件五 APPENDIX 5
網路交換器 Ethernet Switch	TN-5510-4PoE-2GTXP	MOXA	附件六 APPENDIX 6
TETRA 無線電控制平台 TRCP	UFO-Link-CL-TRCP	UFOC	附件七 APPENDIX 7
服務對講機 Service Intercom	UFO-Link-CL-SI	UFOC	附件七 APPENDIX 7
乘客對講機 Passenger Intercom	UFO-Link-CL-PI	UFOC	附件八 APPENDIX 8
TETRA 無線電介面單元 (包含廣播放大器 和 DC/DC 電源供應器) TRIU (including PA Amplifier ,DC / DC Power supply)	UFO-Link-CL-TRIU	UFOC	附件九 APPENDIX 9

## 13 附件 APPENDICES

附件一：概念設計審查意見在細部設計文件中回覆之匯整表 – 列車通訊系統

**APPENDIX 1 : THE LIST OF CONCEPTUAL DESIGN REVIEW COMMENTS TO  
BE ADDRESSED IN THE DETAILED DESIGN DOCUMENTS – ON  
TRAIN COMMUNICATION SYSTEM**

附件二：TETRA 無線電車機設備規格

**APPENDIX 2 : TETRA RADIO MOBILE SPECIFICATION**

附件三：TETRA 無線電天線規格

**APPENDIX 3 : TETRA RADIO ANTENNA SPECIFICATION**

附件四：車廂廣播喇叭規格

**APPENDIX 4 : PA SPEAKER SPECIFICATION**

附件五：直流電源放大器規格器

**APPENDIX 5 : DC/DC POWER SUPPLY SPECIFICATION**

附件六：網路交換器規格

**APPENDIX 6 : ETHERNET SWITCH SPECIFICATION**

附件七：TETRA 無線電控制平台和服務對講機規格

**APPENDIX 7 : TRCP AND SERVICE INTERCOM SPECIFICATION**

附件八：旅客對講機規格

**APPENDIX 8 : PASSENGER INTERCOM SPECIFICATION**

附件九：TETRA 無線電介面單元規格

**APPENDIX 9 : TRIU SPECIFICATION**

附件十：車載通訊系統 旅客緊急對講機(PI) 操作流程

**APPENDIX 10 : OTC PASSENGER INTERCOM (PI) OPERATION FLOW**