

Dynamic Group Assignment (DGNA) is used to send Groups to radios that not already have these groups programmed.

- 3.5.9.1 Assigning subscribers to DGNA
  - 1: Right click on a group to be assigned
    - If it is not desirable to assign a group already programmed into the tetra terminals, a new group specific for DGNA should be defined in the Subscriber Register
  - 2: Select function; "Add Group(s) to DGNA"
    - This selects the parent group for the DGNA •



Figure 3-63: DGNA group Assignment

3: Right click on a subscriber(s) to be assigned to the DGNA group. More subscribers may be selected by holding down the <Shift> or <Ctrl> keys

4: Select "Add mobile(s) to DGNA)

<li>10 Ki</li>	nd *	68	
Home	📥 Associated	🛛 🌟 Favorites	
-	Number	Le er	1
8	1700001	Add mobile(s) to DGNA	
<b>**</b>	1700002	Add (houp(s) to DGNA	
<b>*</b>	1700003	DGNA history	
<b>**</b>	1700004	Select mobile on map	
<b>#</b>	1700005	Enable/Disable History	
8	1700006	Add to Favorites	
8	1700080	Damm GPS Group	
8	1700090	Damm DGNA Group 1	
	1700142	Hans Damm HH-WS	
MR .	1700322	Enk Olesen	
	1700431	Gerhard Christiansen	
	1700432	Finn Drasbek	
	1700524	Dispatcher Support	
	1700123	Hans Damm 3 (TEA1)	
	1700302	Erik Olesen	
	1700401	Gerhard Christiansen	
1	1700402	Finn Drasbek	
-	1700403	Charlotte Åkesson	
	1700423	Palle Teisner Jensen	
	1700502	Bjarne Krog	
(P)	1700503	Asger Haitmann	

Figure 3-64: DGNA subscriber selection



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lobiles	Number	Description
	1700401	Gerhard Christ
	1700402	Finn Drasbek
	1700403	Charlotte Åke
	1700423	Palle Tejsner

Figure 3-65: DGNA subscriber Assignment

Alternatively it is possible to drag and drop the selections to the DGNA group window



Figure 3-66: DGNA Drag and Drop Selection



6: Repeat 3 and 4 if more subscribers are to be assigned to the DGNA group

7: After assigning subscribers, the DGNA group is transferred to the mobile by selecting "Assign the parent group to the mobile"



Figure 3-67: DGNA Assignment

- 3.5.9.2 De-assigning subscribers to DGNA
  - 1: Select group or subscriber to be de-assigned and press the use de-assign icon





Figure 3-69: DGNA de-assigned terminals

3.5.9.3 Showing DGNA history

- Right click on the group or subscriber
- Select DGNA History



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Asger Hart 1700503:	Asger Hartmann	nistory					
	Start time	Timestamp	Group	Group name	Mobile	Mobile name	Status
Terminated	2010-02-19 15:43:05	2010-02-19 15:43:06	1700090	Damm DGNA Group 1	1700503	Asger Hartmann	Succeeded
Terminated	2010-02-19 15:39:12	2010-02-19 15:39:13	1700090	Damm DGNA Group 1	1700503	Asger Hartmann	Succeeded
							*

#### Figure 3-70: Individual Subscriber DGNA history

1700090:	Damm DGNA Gr	oup 1					
	Start time	Timestamp	Group	Group name	Mobile	Mobile name	Status
Terminated	2010-02-19 15:43:15	2010-02-19 15:43:16	1700090	Damm DGNA Group 1	1700502	Bjarne Krog	Succeeded
Terminated	2010-02-19 15:43:06	2010-02-19 15:43:15	1700090	Damm DGNA Group 1	1700401	Gerhard Christ	Failed due to not reachabl
Terminated	2010-02-19 15:43:05	2010-02-19 15:43:06	1700090	Damm DGNA Group 1	1700503	Asger Hartmann	Succeeded
Terminated	2010-02-19 15:39:20	2010-02-19 15:39:21	1700090	Damm DGNA Group 1	1700502	Bjarne Krog	Succeeded
Terminated	2010-02-19 15:39:12	2010-02-19 15:39:13	1700090	Damm DGNA Group 1	1700503	Asger Hartmann	Succeeded
Terminated	2010-02-19 14:49:03	2010-02-19 14:49:04	1700090	Damm DGNA Group 1	1700502	Biarne Krog	Succeeded

Figure 3-71: Group DGNA history

#### 3.5.10 SDS Functionality

All outgoing SDS traffic from the Dispatcher is initiated from the Call Dialog which is available in the SDS and Phone Book windows. The predefined Status SDS's in the list are Organization in-depended, since they are completely transparent to the infrastructure. The predefined Status SDS list is located in a file named StatusSds.txt on the local dispatcher PC.

All incoming SDS traffic to the dispatcher is placed in the inbox; please see <u>Figure 3-72</u>. This includes both text and status SDS's.

An open or closed envelope indicates whether the SDS has been read or not

idos i ante se	120				20
S X	<b>1</b>				_
Inbox	🖬 Ошвак				
	Date/T	From	From (Desc)	Message	
	2010-02-23 1_	1700502	Bjame Krog	TEST	
-0					
ST					

Figure 3-72: SDS Inbox

All outgoing SDS traffic from the Dispatcher are copied to the SDS Outbox, see <u>Figure 3-73</u>. This includes both text and status SDS's. The status of any requested SDS Reports is indicated here by icons.

The types of SDS reports which are supported are:



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# Delivery/consumed Report Request

The receiving Terminal shall report when the SDS has been received.

- Action accomplished
  - The receiving Terminal has opened (read) the SDS.

Inbox	Dutbox				
	Date/ 🤟	To	To (Desc)	Message	
	2010-02-23	1700502	Bjarne Krog	Test Answer	

Figure 3-73: SDS Outbox

In the figure above, the left icon shows a SDS send with flag for Delivery- and Consumed Report set.

The figure changes to 🕸 when the SDS has been read / consumed

# 3.5.10.1 SDS details

SDS details may be displayed by right click on the specific SDS message and selecting "Details"

2010-02-3	23 10:51:40 Biarna Krog	
1100302.	bjanie krog	7
Sendt	2010-02-23 10:51:40	
From	1700522: Bjarne Krog 1700502: Bjarne Krog	
Ack reques	Yes	
Read regul.	Yes	
Last report	SDS receipt acknowledged	
Last report	2010-02-23 10:51:40	
Status	Acknowledged	
Validity peri	none	
Test Answer		0

Figure 3-74: SDS Details

3.5.10.2 Receiving Emergency SDS

Emergency calls will be indicated in the SDS call window as a red bar containing the standard SDS options.



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Also an alarm tone will be played and can be reset by answering / selecting the call

1 505				-	
	图				
E Inbos	Dutton				
	0.3e/7	From	From (Decc)	Mentage	-
5.0	2010-02-25 1	LIGHTLE	Dupatches Sagest	Kinke Ul Linesperce	
8	2010-02-23 1	1708524	Dispatcher Support	fuilte	
6	2010-02-23 1	(\$6777213)		(Code: 65024) General status activo	
6	2010-02-25 1	1700502	Bjare Kog	Reply in Test Assures	
2	AALK AN AR 12	( and the second	Cen 11.	****	1.15

Figure 3-75: Emergency SDS

The icons associated with the emergency SDS are:

SDS received

SDS answered

3.5.10.3 ADU200 emergency alarm box

Please refer to the configuration section 3.5.3.2.6 external devices



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#### 3.5.12 Detach Map

The map window may be detached from the main dispatcher window and placed anywhere on the PC monitor(s)

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This detachment is accomplished by selecting the detach/attach icon positioned in the upper right hand corner of the map window. To attach again, select the detach/attach icon once more

#### 3.5.12.1 Positioning

The TetraFlex<sup>®</sup> dispatcher offers GPS positioning

Positions may be shown as a function of automatic positioning information send from the terminals or as a manual request from the dispatcher. This functionality uses WG84 map coordinates together with Google Maps or one of the other supported map formats.

It is also possible to add layers in ESRI Shapefile format on top of one of the supported maps (except the standard Goggle map format) e.g. for showing details that are not on standard maps.

Positions are shown as green circles and position history as yellow. When moving the mouse over the circle, the data and time for the subscriber is shown.



Figure 3-76: Positioning Google

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To request the position of a subscriber, right click on the phonebook entry and select the option you want:

()	Select mobile on map
()	Select Node on Map
3	Center on map
8	Position History
0	Request position
0	Start Sepura Performance Reports

• Select mobile on map - This highlights the GPS position of the radio on the map 1701101: My Radio 2011-12-02 10:20:44

with big green circle and subscriber details

- Center on map Center the GPS position on the map
- Position History Shows the Position History window and the historic GPS position on the map as yellow circles
- Request position This request the actual GPS position from the radio. This could be usefull when the radio has a long scan period for delivering GPS coordinates and you want a position here and now.
- Start Sepura Performance Reports This function is at the moment only available in Sepura radios and is use for getting the RSSI downlink measurment from the radio.

#### 3.5.12.2 Configuring positioning

At present the TetraFlex<sup>®</sup> relies on the mobile to send positioning to a group. Any group may be used, but it is recommended to create a specific positioning group. This GPS to Group assignment must be set from the radio programming tool.

The position information SDS from the mobile is send to the group. The dispatcher is as rule "member" of all groups, so the dispatcher will pick up the SDS information, process and show it as a position on the map.

Positioning SDS's are filtered out and will not be shown in the dispatcher SDS inbox

3.5.12.3 Overlay file in ESRI map (.shp) format

NOTE: The use of overlay files in ESRI format is dongle controlled.

You can use ESRI overlay maps on top Google premier maps, OpenStreet maps, Raster maps and the Empty map option. Standard Google maps are not supported with overlay maps. The Dispatcher uses a flag in the Dongle in order to enable and disable the ESRI shape file view.

The current used overlay files are saved together with the used map and will be re-loaded when the map view / dispatcher is started again.

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To load a new overlay file use the *solution* folder icon. When loaded it will be available in the overlay list



By Right clicking on the overlay in the menu, you get the possibility to **Delete** them again, make them **Visible** or not Visible and to move the layer up and down (**Move up, Move down**) in the different layers on the map e.g. if two layers are overlaying each other you can change which one should be in front.



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#### 3.5.12.4 Other map options

The **Show (all)** menu makes it possible to select what GPS coordinates you want to show on the map:

- Show all Shows the GPS coordinates for all radios, registered and not registered (not registered are shown with a dark green color).
- Show registered Shows only the registered radios. If a Radio comes out of coverage, the battery is removed or in another way comes unavailable without de-registering is will still be shown on the map as registered.
- Show history Shows the historical plot of GPS coordinates for the selected radio.

With the icon you can change the map view between Road map, Satellite or Hybrid This option is only available in Google premier maps and on Google standard map (map and satellite).

Toggles between showing grid line on the map and no grid lines (not available on Google standard map)

Toggles between showing the nodes on the map or not. (not available on Google standard map)

Show / hides lines between history points on the map. (not available on Google standard map)



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#### 3.5.12.5 RSSI measurement plot

#### (not available on Google standard map)

When changing the map view to History view you get the option to plot RSSI measurement on the map as different colors depending on the RSSI level. This can be used for making a coverage map or just to see the RSSI levels of a radio on the map.

Map		
Show history for 1700502:	John Rosenberg 👻 🚱 🖽	· 🇆 - 🕷 🌋 🐘 - 🧶 -



- Only history shows only the historical GPS positions
- Uplink RSSI Shows the RSSI level the actual node measures for a given radio
- Downlink RSSI Shows the RSSI level the radio measures to the connected node (only possible on Sepura radios with the Sepura Performance Report enabled)

# 3.5.12.6 Send file

It is possible to send files between two dispatchers by clicking the on the dispatcher you want to send the file to in the Phone book list:



When selecting Send Files you get the file transfer container:

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File Trar	nsfer Container					X
😂 🗶	<u><u></u></u>					
Identity	1700524					
	1700524: Dispatcher Support					
Sub						<b>v</b>
File		Size	Date			
C:\temp\c	e4fca7b-6176-45a9-a9a0-6d2e92729b6bDispatcher.log	23 KBytes	2011-03			
					Send	Cancel

Here you can either drag and drop the files you want to send from e.g.. the file manger or you

can use the file menu kit to get the open dialog from where you can select the files you want to send.

When the receiving dispatcher receives the file(s) a notice will come in the mail box icon in the process line and the file(s) will be shown in the File Transfer window that you can choose from the menu:

😽 File	e Transfer						
۵.	🗋 💿 🗙	<b>X</b>					
Inbox	Outbox						
	Date/Time	From	From (Desc)	Files	Size	Status	
<b>~</b>	2011-12-0	1700524	Dispatcher Supp	ce4fca7b	3 KBytes	Succeeded	
-							



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# **3.6 LOG SERVER**

# 3.6.1 Description

A TetraFlex<sup>®</sup> Log Server is a network component that can be placed anywhere in the TetraFlex<sup>®</sup> Network's infrastructure. Once connected, it will automatically start to record the status of all Nodes in the TetraFlex<sup>®</sup> network, without any configuration. Furthermore it can be setup to log statistics (default, always present), SDS, Call records and Voice Communication, or a combination of these functions (dongle controlled)

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The TetraFlex<sup>®</sup> system supports the attachment of one or more Log Servers to the system. The Log Server is developed to run on a Windows platform.

For single-site and small systems the Log Server can be installed on and run from the BSC412 or BSC421.

For bigger systems the Log Server must run on DAMM Log Work Station or on a DAMM Log Server Station.

3.6.2 General Description

# 3.6.2.1 The TetraFlex<sup>®</sup> Network and the Log Server

The TetraFlex<sup>®</sup> network infrastructure consists of TetraFlex<sup>®</sup> Nodes which are connected through a backbone IP net as illustrated in Figure 3-78

Log Servers are passive network elements that can be attached anywhere in the infrastructure, only requirement is IP connectivity to the backbone network. When attached the LogServer will automatically be joining a specific log server IP multicast address on which all Nodes send status and call information.

The Log Server is capable of:

- Logging the status from all Nodes in the TetraFlex<sup>®</sup> network.
- Logging Call information (Call Data Records) for all mobiles.
- Logging Voice Communication for selected mobiles.
- Logging the mobiles Node location and on/off state for selected mobiles.

The Log Server automatically starts to log the status from the TetraFlex<sup>®</sup> Nodes. In addition, it can be setup to log all calls (CDR without voice) and SDS on the system, and optionally log Voice Communication and Node location for selected mobiles. The Log Server logs all data to a database, managed by a SQL Server.

In Figure 3-78 TetraFlex® Network with Log Server, the SQL Server and the Log Server are running on the TetraFlex<sup>®</sup> Log Server machine.



Figure 3-78 TetraFlex<sup>®</sup> Network with Log Server

It is possible to attach one or more TetraFlex<sup>®</sup> Log Servers to the infrastructure, either on dedicated Log Server machines or on a BSC412 or BSC421, all depending on the network load.

# 3.6.3 Log Server Maintenance

The database should be backed up on a daily basis; the backup should be saved to an external media, such as Tape, external disk, and network server or similar.

The Log server can be setup to perform a scheduled maintenance, which can run on specified interval. It is also possible to make the "Maintenance now".

The Maintenance parameters are setup via the LogClient, but the LogClient itself has nothing to do with the execution of the maintenance this is totally done by the log server based on the settings made by the client.

The maintenance is performed by the LogServer, which executes 2 steps: An optional backup of the database files to a network share, and an optional cleanup old data. Each of these steps can be disabled independently of each other.

It is recommended to enable the scheduled maintenance with backup and automatic cleanup enabled. There are several of good reasons for this:

- Keep the database from running out of disk space.
- backup the database to an external disk to ensure data in case of disk crash.
- Keep high performance when querying data from the database.

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#### 3.6.3.1 Scheduled Maintenance

The scheduled maintenance parameters are set up via the LogClient. Open the settings view and select the database tab.

Settings			
Database Node	s Subscriber Sound LogServer	r Licenses LogServer Confi	g
Database Set	tings (Client)		
SQL Server	10.239.16.200	Database Name	TetraFlexLogDB
Login	root	Password	•••••
		Connect ! Re	eload Settings Save Settings
⊂ Database Mai	ntenance		
Enable	scheduled maintenance	9 22:00:00	
Start mainte	enance at 00:00:00 🗢	Maintenance interval	Weekly
Backup	database		
Backup net	twork share (accessible from LogSer	ver) \\Server-File\Damm\S	Support\John\TetraStar_L Browse
Cleanup	o database records (after backup)		
Delete reco	ords older than 14 d	ays	
	Maintenance Now Ma	intenance History Re	eload Settings Save Settings

Figure 3-79 Log Client Setting view –Database tab

- 1. In the Database maintenance group box, you can enable/disable "scheduled maintenance", "database backup" and "Cleanup database records".
- 2. To set up scheduled maintenance set a check mark in "Enable scheduled maintenance".
- 3. Now set the start time to a time where the TetraFlex traffic load possibly is low, i.e. midnight.
- 4. Finally set how often this operation should be performed in "Maintenance interval". The Maintenance task can be executed each day, every week, every 2nd week, or every 4th week, depending on the selected "Maintenance interval".

To enable backup of database put a check mark in the "Backup database" checkbox. Now you must supply a fully qualified network path to the backup share you are using. This must be on the form \\<BackupServer-IP>\<Share> seen from the LogServer; local drives and mapped drives are not allowed because they are not available when the LogServer is running with no one logged in. Login credentials must have write permissions in the supplied destination share.

E.g.: Figure 3-79 the Backup network share is set to:

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<u>\\Server-File\Damm\Support\John\TetraStar\_Logserver\_Backup</u> this is a network destination where the log server has access.

To enable the scheduled database maintenance settings you have to click the "Save settings" button. When you do this, you will be requested to enter the login credentials for the Backup Destination Login.

Backup destination login (ho	m LogServer)
Enter a valid login and pass	vord to backup network share:
127.0.0 1\FlashBackup	10929 (BORNESS CONSTRUCTION)
CONTRACTOR OF A DESCRIPTION OF A DESCRIP	
SE AWARE	
BE AWARE: Login credentials must have	write permissions in the supplied network share.
BE AWARE Login credentials must have	write permissions in the supplied network share.
BE AWARE Login credentials must have Login <b>Difuse</b>	write permissions in the supplied network share.

Figure 3-80 Backup destination login credentials

When the scheduled maintenance is saved and enabled, you can see when the next scheduled maintenance task is executed in the Next scheduled maintenance task field, see **Error! Reference source not found.** 

Enable scheduled r	maintenance			
est scheduled mainte	nance task: 200	09-11-03 00:00:00		
tatt maintenance at	00:00:00	Maintenance interval	Daily	~

Figure 3-81 next scheduled maintenance task

To enable or disable cleanup of old database records set or remove the check mark in "Cleanup database records (after backup)", and specify the cleanup threshold in the "Delete record older than" edit box. The scheduled maintenance executes the database backup as the first step (if selected), when this succeeds it continues to clean up the old database records from database.

# 3.6.3.2 Maintenance Now

The LogClient offers the possibility to check/test your database maintenance settings by initiating the database maintenance immediately. Be aware that the "Maintenance now" is executed with the saved "Backup database" and "Cleanup database records" settings. These settings are shown in the confirm dialog, see **Error! Reference source not found.** 



Figure 3-82 Confirm manual maintenance



When accepting the settings by clicking OK, the maintenance is initiated by the LogClient, and will be executed by the LogServer within the next minute. It is possible to follow the maintenance progress by accepting this, see fig.3.82.

LogClie	nt 🔀
	The Maintenance will be performed by the LogServer within the next minute. Do you wish to follow the Maintenance progress?
	OK Cancel
igure	e 3-83 Follow maintenance progres

The Maintenance progress is shown in the "Additional info maintenance" dialog, see Fig. 3.83. The rows and fields in this dialog are filled as the progress information becomes available.

3.6.3.3 Maintenance History

Once the maintenance has finished, the result of the maintenance can be found in the Maintenance history. Open the "Maintenance History" dialog to see the list of executed maintenance jobs. Each maintenance job has a row containing info about: start- and end time, the result (OK or Error), the type of maintenance executed, backup destination and cleanup of old records. See Maintenance history in **Error! Reference source not found.** below.

Testedance startest	Mantenance ended	Information	Marctenance status	Exclup Destination
3009-11-09 12:50:16	1009-11-09 12:00:35	OK.	Scheduled Backup and Cleanup	)(127.0.8.1)PlantBackup/LAE_SOPTWARE_1(20095109_)
3009-11-09 11:43:25	1009-11-09 11:43:45	OK.	Henuel Backup and Cleanup	1127.0.0.191ah8ackup1285_SOFTWARE_1120001109_1
1009-11-09-1110/001	1009-11-09 (1-07)55	là :	Hersal Badue and George	WEET-OIL LYNEMINESUPLIAE SOPTIMUST 152000001

Figure 3-84 Maintenance history

To remove an old Maintenance job choose the row, then press the remove button. The Maintenance registration and the corresponding backup files will be removed and deleted. To get additional info about a specific maintenance job, select a job and press the button "Additional info", see fig. 3.84

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Rant taval 2009-11-0 Inditerat: 2009-11-0 Ratus: OK	911:07:02 Backup Ty 911:07:05 Destinate Status Te	pe: Manu n: Yitzz n: Manu	el Martemarce Ceanag Re D.S. L'Alektrasiug ILAB_SOFTWARE_JU2001LDV_J10752 el Badug and Ceanup	cords Older Thans 14 Days	
etaled Bachap Diatus					
Sat we	Endline	Ratus	Status Text	Table Name	1
2009-11-09 11:07:33	2009-11-09 11:07:49	Babut	Copying Database Nes succeeded	CASH OLA	
2009-11-09 11:07:49	2009-11-09-11:07:95	Bahar	Capying Lepthers, ave aucceeded. Destanation: ((327.0.0		
2009-11-09 11:07:55	2009-11-09 11:07:55	Classic	Deleted 0 records older than 2009-10-26 00:00:00	GroupCal	
2009-11-09 11:07:55	2009-11-09-11:07:55	Gearup	Delated 0 records older then 2009-10-20 00:00:00	GroupPtt	
2009-11-09 11:07:55	2009-11-09-11:07:55	Gearap	Delated 0 records older than 2009-10-26 00:00:00	IndividualCal	
2009-11-09 11:07:55	3009-11-09 11:07:95	Gearup	Deleted G records older than 2009-10-26 00:00:00	IndividualPtt	
2009-11-09 11:07-55	2009-11-09 11:07:95	Geanip	Deleted 0 records older than 2009-10-26 00:00:00	CallvathorizedDispetcher	
2009-11-09 11:07:65	2909-11-09 11:07:95	Geanp	Deleted 0 records older than 2009-10-26 00:00:00	Vice	
2009-11-09 11:07:55	2009-11-09 11:07:55	Geanp	Deleted 20 records older than 2009-10-26 00:00:00	MsLocationLing.	
2009-11-09 11:07:55	2009-11-09 11:07:95	Gearap	Delated 11 records older than 2009-10-28 00:00:00	Serverlag	
2009-11-09 11:07:55	2009-11-09 11:07:55	deexp	Delated 0 records older than 2009-10-20 00:00:00	NodeStatuning	
2009-11-09 11:07:55	2009-11-09 11:07:55	Carsp	Deleted 0 records older than 2009-10-26 00:00:00	SdiStatur	
2009-11-09 11:07.55	2009-11-09 11:67:85	Gearap	Deleted 7 records older than 2009-10-26 00:08:00	ShiData	
¢ :					

Figure 3-85 Additional info maintenance

In the Additional info maintenance dialog each action performed in the maintenance job is listed.

3.6.3.4 Manual backup of the database

The MySql Server is set up to use the MyISAM storage engine. MyISAM manages nontransactional tables which provides high-speed storage and retrieval of data. The database can be backed up simply by copying the database files. Don't forget to backup (copy) the logClient executable which is located at: \\<logServer>\Tetraflex\LogClient\Files\LogClient.exe.

The TetraFlexLogDb database is stored either under the default MySql data path:

C:\Program Files\MySQL\MySQL Server 5.0\data\tetraflexlogdb

or on systems with more partitions:

E:\Tetra\Applications\LogServer\Database\ tetraflexlogdb

Copy this folder and the LogClient executable to an external storage to make your manual backup.

To find the physical database files location look in the MySql configuration file: C:\Program Files\MySQL\MySQL Server 5.0\my.ini find the following line starting with datadir, i.e: datadir="C:/Program Files/MySQL/MySQL Server 5.0/Data/"

3.6.3.5 Restoring a database

The scheduled maintenance backup files are stored under the supplied path entered in Scheduled maintenance; see section 3-98 Scheduled Maintenance for further info. The backup contains the database files as well as the LogClient which is able to read it.



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	10091109	110732			S 🛃 🛛	
Folders	×	Name -	Sm	Type	Date Modified	-
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£ 2004109_10025		6		Contract.		đ
113 philette	-	122	_	(E 4D MI)	Mu Constates	-

Figure 3-86 Backed up files

Copy the backup directory which is named with the timestamp on the form <YYYY-MM-DD\_hhmmss> to the MySql database directory.

**Important**: When the copy has finished, the MySql Server locks the files and you will no longer be able to rename or delete the database files. The MySql service has to be stopped to delete or rename a database folder.

It should now be possible to connect to the MySql server and select the database with the LogClient, see fig. 3.87. To restore the backup press the connect button. On success you will get a "Connect to database succeeded" dialog, see fig. 3.88.

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Figure 3-87 Selection the database backup

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100	- 1		

Figure 3-88 Backup restored

NUM-OVE

The LogClient is now connected to the restored database and you can only browse through the "old" data till you select the active running database named "TetraFlexLogDb".

Note: if you have not saved the "database settings (Client)", then a restart of the LogClient will make the LogClient connect to the previous selected database.

# 3.7 TETRAFLEX<sup>®</sup> LOG CLIENT

# 3.7.1 Description

The TetraFlex<sup>®</sup> Log Client application is developed to run on a Windows XP or Win7 platform or a Terminal Server where multiple users can run their own instance of the TetraFlex<sup>®</sup> Log Client at a time.

The TetraFlex<sup>®</sup> Log Client application requires access to the SQL-Server and has the following properties:

- There is no user validation. Dongle configuration controls the level of database query
- Hardware Dongle required.
- It is able to query CDR records from the database for:
  - Group- and individual calls
  - SDS Status
  - SDS TL
  - SDS Data
  - SDS Application

Queries can be made for a specified time interval as well as "Only from", "Only to" and combination of this.

$\infty$	D	A	M	Μ
Damm Cellul	ar Syste	ems A/S	Denma	ark

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- Set up query and replay Voice data from the database for voice logged group- and individual calls for a specified call.
- Set up the latest MS Registrations, and also historical registration data for the mobiles.
- Set up to monitor the status of the Tetra network.
- Set up to present statistical data showing the performance of the TetraFlex® Network.
- Set up the Subscriber configuration, meaning setting up which mobiles should be "location and voice logged", and which groups should be voice logged.
- Set up the logging priority for the selected individual and groups
- It is able to switch database without restart of the application.
- Selecting temporary storage for voice playback files

#### 3.7.2 Functionality

When the TetraFlex<sup>®</sup> Log Client application is launched the main window appears:



Figure 3-89: Log Client - Main window

From the Log Client toolbar it is possible to open the Statistics-, CDR-, MS Reg.-, Status- and the Settings view.

Note that the title bar indicates which SQL Server and database the application is connected to.

#### 3.7.3 Statistics View

The Statistics view has five tabs

On the statistics window of each tab it is possible to right click to open the configuration dialogue. The configuration dialogue also includes export options

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Statistics for node: 011 S000 Sønderborg TermServ/GW2

e 100 📫 😥 🧮 damay kan 🚛 kana pan 🛲 Buo	Packet Da	ta Gateway Alarm	
00 00	Newerg Style Dorder Style Font Style	<ul> <li>Color</li> <li>Nonadrome</li> <li>Monadrome + Symbol</li> </ul>	
alved EThu EF# 7Sat ISan 3Mon 1	<ul> <li>Show Legend</li> <li>Numeric Precision</li> </ul>	• Striop / Gradievit Styles	17 Tue 18 Weel 19 Thu 20 Fit 24 Set 22 Sus 23 Non 24 Tue
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Exporting	Packet Da	ita Gatewa	y Alarm			
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Export De	stination ard					
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1	width: 152.	400 /	101.600	Millimeters		Export
	DPI: 300	~	Large F	ont		Cancel

Figure 3-91: Export Dialog example

# 3.7.3.1 Node

Shows the Node Alarm as percentage of time

Indications are

- OK
- Warning (L1)
- Alarm (L2)
- Blocked (L3)
- Shutdown
- Missing

amm Cellular Systems A/S, De	enmark TETRAFLEX <sup>®</sup> V7.5	MANUAL - TetraFlex® Lo	og Client
· Perwork Statistics			
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Annale Margaret			
And the second sec			
	Node Alarm		
and a second a second	Node Alarm	_	
and a second in the second sec	Node Alarm		
	Node Alarm		

Figure 3-92: Node

# 3.7.3.2 Radio

The Radio tab has 3 sub-tabs

All tabs has a selection of resolution to 1 minute, 10 minutes, 1 hour or 1 day All tabs has the selection of table or graphic view

# 3.7.4 Radio Cell Alarm

Shows alarms as percentage of time



3.7.4.1 Radio Cell Timeslot

Figure 3-93: Radio, Alarm

Shows timeslots as function of Erlang



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rode Pole vace by radial pata cel 1 A	en.99		
Statistics for node: 008 S008 Sana	lerborg Vandtärn		
Radio Call Alarm Radio Cell Terviolata Radio C	Of Congestion		
		Radio Cell Timeslots	
E E			
Newskitt Newskitt			
27.54	22.366	ZT Mon	24 Ter

Figure 3-94: Radio, Timeslot

Congestion shows the traffic load in percentage, and Timeslot showing the average timeslot distribution for a specific node. The user has to enter resolution time and specify a Node.

The timeslot types displayed are:

Timeslot table	
Timeslot type	Description
ССН	Control Channel. (MCCH and SCCH)
Group Call TS (GTCH)	Timeslots used for group calls.
Individual Call TS (ITCH)	Timeslots used for individual calls.
Packet Data TS (PDCH)	Timeslots used for packet data.
Idle TS	Unused/Idle timeslots ready for traffic.
Blocked TS	Blocked timeslots which cannot be used for traffic.
Spare TS	Spare timeslots used for redundancy if a transceiver drops
	out.
Missing Data	No connection between node and log server

# 3.7.4.2 Radio Cell Congestion

Shows timeslot usage as percentage of time

e Resolution C 18 C 108 C 18 C 18	Redit: 003 5003 H.C.	Distediveniet			w .	Chart) Te
ada Fradki Voka GW Paciat Data GW Ap	p GW				- 10	
tatistics for node: 003 6003 H C 3	and a second at					
1005005 FOT HOUR, 000 3000 FLC30	The share of the state of the s		D			
ante Califforni Darte Californisto - Rada Ce	Congettion		14.			
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Figure 3-95: Radio, Congestion



3.7.5 Voice GW

Voice GW tab has 3 sub-tabs

3.7.5.1 Voice GW Alarm

Shows alarms as percentage of time

		101	STREET, STR
se Recolution () be () blev () (1) () 1d	Nede: 012 5000 Sendedurg Terreserv/WW2	~	( Oating
ode Rade Voice GW Padvet Date GW App	6 GH		
tatistics for node: 011 S000 Sønde	arborg TermServ/GW2		
race GW Alerti Islace GW Channels Islace GW	Cangeston		
	Voice Gateway Alarm		
100 - CA 100 PARAULT) 100 -	and p. 2. 🛲 Record to 1000 per consume to 200 Persons 🛲 Manag	- Norman and the	
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Figure 3-96: Voice GW, Alarms

# 3.7.5.2 Voice GW Channels

Shows GW channels related to Erlang

	Loss Taxatan Phys.				100	Contact 17
elessation (Cite (Cite) (Cite) and an and	porg remote optime				-	Coner/ in
ide Radio Volce GW Packet Data GW App GW						
tatistics for node: 011 S000 Sønderborg TermServ/GA	N2					
		I				
Nace Gai Marn Vince Gai Channels Vision Sai Cangestion						
	Voice Gatew	ay Channels				
and Anton and Mar and Marchaeller	II and the second se	and the second				
5 A	1					
#20						
g 10						
5 <sub>6</sub> <b>1</b>						
#Wed SThu 6111 TSat 55an 98an 101a	11 11 West 12 The 13 Mil	14 Sal 15 Suo 18 Mor	17 has 10 Ved 1	a thu 30 Pri	21.5et 22.5et	25 Mon 34 Tu

Figure 3-97: Voice GW, Channels

3.7.5.3 Voice GW Congestion

Shows GW congestion related to percent of time



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ande   Radio   Noce ON   Racket Data Gir   App	Gel					
Checking and the second s						
tatistics for node: 011 S000 Sende	rborg TermServ/GW2					
	9111 T. (* 511577 * 516754)					
Nace Gill Marts - Voice GW Channals - Voice GW	and searching to					
	ordateou					
	-angestavi	/oice Gateway	Congestion			
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500 The second s	anna y harvery 🗯 Mysery Dat	/oice Gateway	Congestion			

Figure 3-98: Voice GW, Congestion

# 3.7.6 Packet Data GW

Shows GW alarms related to percent of time

me Resolution: O Tes O 10m @ Th. O 1d	Node: 011 SD00 Sanderborg Ten	nServ/GW2			~	Over/1
ede   Radio   Vace Gw   Packet Data GW   Ap	(sw)					
tatistics for node: 011 5000 Send	rborg TermServ/GW2					
			P			
Realized Plants and Alexand			Contraction of the second s			
Papat Laca ure Harti						
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100 Ce 200 Weeks	er 1.7 🗯 namer 1 📰	acket Data Gat	eway Alarm	ll al		
100 Ce 33 verng1.17	enta 🛋 nenga 🗮	acket Data Gat	eway Alarm			

Figure 3-99: Packet Data GW, Alarms

# 3.7.7 Application GW

Application GW has 2 sub-tabs

# 3.7.7.1 Application GW alarms

Shows GW alarms related to percentage of time

Autwork Statistics		
ne Resolution C tan C tan C tan C ta C ta Acade C to 5000 Senderburg Tereben (Sect	<u>(w)</u>	Chart/Table
Statistics for node: 011 S000 Senderborg TermServ/GW2		
Ann Cite Marry Anno 1916 Comparison		
Application Gateway Alarm		
200 Contraction of the second state of the sec		
		-
	New more	

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#### Figure 3-100: Application GW, Alarms

# 3.7.7.2 Application GW congestion

Shows GW channels related to Erlang

a Pacolution	1m () 10m () 1	b Old	Node 102 TE2	7-N0021 AB 2		Chart ( Tab
ode Radio Vo	ice GW Packet I	Data GW App (	SW.	an the Andrew Deep Hole and the A		contract rate
tatistics for I	node: 002 Ti	F27-N002 L/	AB 2			
App GW Alarm A	pp GW Connectio	ns				
		Applicati	on Gatewa	y Connectio	ns	
[20 Activ	ve <b>Int</b> idle I	Blocked	Missing Date	a		den er de
원 비 일 15						
5-						
0 5 Fri 7:00	8:00	9:00	10:00 1	1:00 12:00 3-05	13:00 1	14:00 15:00

Figure 3-101: Application GW, Connections



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#### 3.7.8 CDR View

In the CDR View the Call Data Records are presented. The user must enter Search Criterion as the time period and specify whether it is group-, individual- or SDS type- calls to narrow the number of hits. It is also possible to specify a single From and/or To subscriber. When Search Criterion is entered, press Search button to load the Search Results from the SQL Server.

Search Official ○ Indexidual Call : ○ Gro	up Call C SDS :	Ratur OS	DS-7L OSDS Data OSDS	Appl Only Priority	- 10		Search
Rat time 2009-06-03	₩ 12:37:48	5 D	why from all lighter terms	+ 4.55	Line In		
Dod Time	- 1437.44		why Te All Individuous		Our No		
Results for Group (DRs of From [All Subscribers] To [	ter 2009-06-03 12:3 Al Subection]	7:48 leated to					Additional Info
CellBegin C	al End	Call Duration	Prom	Prov Description	Ta	To Description	11
2009-10-16 10:09:45 2	009-10-16 10:09:55	00:00:10	238 16001:16777184(724221)		238-16001:1000002		238 16001 16777184
2009-10-16 10:08:35 2	009-10-16 10 08:45	00:00:10	238.16001:16777184(1725582)		238 16001 1000002		238 16001 16777194
2009-10-16 10:00:39 2	009-10-16 10:00:55	00:00:16	238-16001:56777104(1729562)		230 16001 1000002		238:16001:16777164
2009-10-16 09:42:24 2	009-10-16 09:42:31	00:00:07	238:16001:16777184(1725502)		258-16001:1000002		238:16001:16777184
2009-10-16 09:41:19 2	009-10-16 09:41:25	00:00:06	238 16001:16777184(1729502)		238:16001:1000002		238:16001:16777184
2009-10-16-09:40:40 2	009-10-16 09:41:02	00:00:19	238:16001:16777104(1729902)		230:16001 (1000002		238-16001-16777164
2009-10-16 09:24:53 2	009-10-16 09:24:59	00:00:06	238:16001:16777184(1725502)		238-16001:1000002		238:16001:16777164
2009-10-16 09:24:32 2	009-10-16 09:24:52	00:00:20	238 16001:16777184(1725502)		238:16001:1900002		238:16001:16777184
2009-10-16 09-23:45	009-10-16 09-24:01	00:00:16	238-16001(16777184(1729502)		238:16001:1000002		238 16001 :16777184
2009-10-05 10:30:12 2	009-10-05 10:33:50	100:02:38	238:16001:16777164(724221)		236:16001:1000000		238 16001:14777184
2009-10-05 10:29:14 2	009-10-05 10:29:36	00:00:22	238(16001)(16777184(724221))		298-16001 (1000002		238:16001 (16777164
2.1			<b>1</b>				14

Figure 3-102: Log Client, Call Data Records

The Search Result lists all the calls matching the Search Criterion, and it contains the relevant call information like Call Begin, Call End, From, To, From Node, Call Priority etc. One row in the result grid reflects one call.

When the Search Result is loaded it is possible to get additional information on a single call, either by double clicking on a single row or by selecting a row and press the Additional Info button.

ditional Ca	l Information									Þ
Call Informatio	n									
Call Id:	70	From SSI:	16777184	To SSI:	1000002	TF	P. SSI:	16777184 C	ircuit Mode Type:	TCH/S
Call Begin:	2009-10-16 09:42:24	From MCC:	238	To MCC:	238	TF	P. MCC:	238 5	ipeech service:	Tetra
Call End:	2009-10-16 09:42:31	From MNC:	16001	To MNC:	16001	TF	P. MNC:	16001 C	Comm. Type:	P2MP
Call Duration:	00:00:07	From User No:	1725502	To User No		TF	. User No.:	1725502 E	2E Encryption:	Clear mode
Seq Numbers:	0-5	From Descr.:		To Descr.:		TF	P. Descr.:	A	I Encr Requsted:	No
CMoIP:	225.0.1.6	Call Priority:	1	r\\				A	I Encr Enabled:	No
CLIR:	Presentation not restri	cted		TPIR:	Presenta	tion not i	restricted			
Disconnect Ca	ause: SwMI requested (	disconnection								
Detailed Inform	nation									
Туре	Start time	End time		Duration	Seq No	Node	Initiating P	arty	Initiating Pa	rty Descripti
Call Initiated	2009-10-16 09:42:24	1		00:00:00.000	0	N001	238:16001	:16777184(1725	502)	
PTT	2009-10-16 09:42:24	\$ 2009-10-16	09:42:25	00:00:00.891	1-2	N001	238:16001	:16777184(1725	502)	
PTT	2009-10-16 09:42:20	5 2009-10-16	09:42:26	00:00:00.341	3-4	N001	238:16001	:16777184(1725	502)	
Call End		2009-10-16	09:42:31	00:00:05.007	5					
<			111							>
Control Panel										
Drewieus CDD						Cha				
Previous CDR	Next CDR					500		ay/rause Pr		Nextern
Status: No Re	cording Loaded.					00:00:0	0.000 📃 –			

Figure 3-103: Log Client. Additional Call Info



Damm Cellular Systems A/S, Denmark

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In the Additional Call Information view, the Talking Parties in simplex calls are listed. It is also indicated whether the Talking Party has preemptive rights and which node the MS is located under.

From this view it will also be possible (if client dongle allows this) to load and playback calls that have been recorded.

# 3.7.9 MS Registration View

The MS Registration view has tree tabs, the Latest MS Registration, the MS Registration History tab and the MS RSSI history tab. When a mobile registers it indicates an Update Type to the Node.

There are 3 Update Types:

Update Type Table	
Update Type	Description
ITSI Attach (Power on)	The mobile has been turned on.
Roaming	The mobile has moved and is covered by a new Node.
ITSI Detach (Power off)	The mobile has been switched off.

#### 3.7.9.1 Latest MS Registrations

The Latest MS Registrations tab shows a live view of the mobiles and their Node location. The list contains one entry pr MS, showing its current Update Type state and which Node that has received it.

🖥 MS Registrations						X
Latest MS Registration	5 MS Regis	stration History				
Latest MS Regi	strations	5				
MS	User No	MS Description	Node	Update Type	Timestamp	^
238:00004:2003108	2003108		001: S001 Svanemøllen	Roaming	2009-02-24 12:34:23	
238:00004:2003122	2003122		003: S003 H.C.Ørstedsværket	Roaming	2009-02-24 12:47:59	
238:00004:2003105	2003105		002: S002 Amagerværket	Roaming	2009-02-24 12:20:37	
238:00004:2012111	2012111		003: S003 H.C.Ørstedsværket	ITSI Detach (Power off)	2009-02-20 17:32:37	
238:00004:1000424	1700424	Uwe Jansen	008: 5008 Sønderborg Vandtårn 🕏	ITSI Attach (Power on)	2009-02-24 07:03:30	
238:00004:2012105	2012105		002: S002 Amagerværket	Roaming	2009-02-24 12:56:02	
238:00004:2003129	2003129		002: 5002 Amagerværket	ITSI Detach (Power off)	2009-01-30 17:04:58	
238:00004:2003111	2003111		002: 5002 Amagerværket	Roaming	2009-02-24 12:46:35	
238:00004:1000302	1700302	Erik Olsen	008: S008 Sønderborg Vandtårn	ITSI Attach (Power on)	2009-02-24 07:36:25	
238:00004:2012110	2012110		001: S001 Svanemøllen	ITSI Detach (Power off)	2009-02-18 12:22:58	
238:00004:2003123	2003123		003: S003 H.C.Ørstedsværket	Roaming	2009-02-24 12:51:28	
238:00004:2012107	2012107		005: 5005 Brøndby	Roaming	2009-02-24 12:54:22	
238:00004:2012102	2012102		005: 5005 Brøndby	Roaming	2009-02-24 12:57:02	
220-0004-2002124	2002124		002: 5002 H C Ørstadaumekat	TTST Datach (Dower off)	2000 02 04 14:20:22	×

Figure 3-104: Log Client, Latest MS Registrations



3.7.9.2 MS Registration History

The MS Registration History tab shows the historical registration data. The user must enter the Search Criterion such as time interval and specify mobiles and Nodes of interest. It is possible to exclude roaming registrations.

The list might contain the same mobile several times.

est PD Registr	ations P	t5 Registra	dion History	1						
Search oriterio	0									
Start time	2009-02-	24 4	07:09:37		inly MS	All Subscr	bers		· China Other No.	Search
End Time		2011	10.01.37	-	niy Nodes	N001		1	Exclude roaming	
Treventarep		MS	au-social	User No	MS Destr	pton	Node		Update Type	-
Status: Regist	tration his	tory after	2009-02-24	07:09:37 k	aded for M	5 (All Subsc	rbers] on Node [001]		100200.00000	
		2. Contract 1. Con					1.000		Department of the	
2019-02-24 0	7:53:40	238-0000	4:2012108	2012108			0011 S001 Svapepallen		BO MENDER OF	has
2009-02-24 0	07:53:40	238:0000	H:2012108	2012108			.001: 5001 Svanemølen	N.	TTSI Altach (Roset on)	
2009-02-24 0 2009-02-24 0 2009-02-24 0	)7:53:40 )7:59:31 )8:04:39	238:0000 238:0000 238:0000	H:2012108 H:2012109 H:2003120	2012108 2012109 2003120			001: 5001 Svanemølen 001: 5001 Svanemølen 001: 5001 Svanemølen	R	ITSI Altach (Power on) Boaring	
2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0	07:53:40 07:59:31 08:04:39 08:09:11	238:0000 238:0000 238:0000 238:0000	H12012108 H12012109 H12003120 H12012108	2012108 2012109 2003120 2012108			001: S001 Svanemøllen 001: S001 Svanemøllen 001: S001 Svanemøllen 001: S001 Svanemøllen	<i>∑</i> ⊗	Roaming ITSI Attach (Power on) Roaming Roaming	
2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0	07:53:40 07:59:51 08:04:39 08:09:11 08:14:42	238:0000 238:0000 238:0000 238:0000 238:0000	H:2012108 H:2012109 H:2003120 H:2012108 H:2003127	2012108 2012109 2003120 2012108 2003127			001: S001 Svanenøllen 001: S001 Svanenøllen 001: S001 Svanenøllen 001: S001 Svanenøllen 001: S001 Svanenøllen	R	Roaming ITSI Attach (Power on) Roaming Roaming Roaming	
2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0	07:53:40 07:59:31 08:04:39 08:09:11 08:14:42 08:43:45	238:0000 238:0000 238:0000 238:0000 238:0000 238:0000	H:2012108 H:2012109 H:2003120 H:2012108 H:2012108 H:2003127 H:2003118	2012108 2012109 2003120 2012108 2003127 2003118			001: 5001 Svanemallen 001: 5001 Svanemallen 001: 5001 Svanemallen 001: 5001 Svanemallen 001: 5001 Svanemallen 001: 5001 Svanemallen	ß	Roaming ITSI Attach (Power on) Roaming Roaming Roaming Roaming	
2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0 2009-02-24 0	07:53:40 07:59:31 08:04:39 08:09:11 00:14:42 00:43:45 08:53:09	238:0000 238:0000 238:0000 238:0000 238:0000 238:0000	H:2012108 H:2012109 H:2003120 H:2012108 H:2003127 H:2003127 H:2003120	2012108 2012109 2005120 2012108 2003127 2003118 2003129			001: S003 Svanenallen 001: S001 Svanenallen 001: S001 Svanenallen 001: S003 Svanenallen 001: S003 Svanenallen 001: S003 Svanenallen 001: S003 Svanenallen	N.	Roaming TITSI Attach (Power on) Roaming Roaming Roaming Roaming Roaming	

Figure 3-105: Log Client, MS Registration History

# 3.7.9.3 MS RSSI History

The MS RSSI history view shows the uplink RSSI values in dBm for the different calls made.

st MS-Registr	ations	MS Registra	abon History MS P	Liss History							
earch arterio	-										
Cart time	2011-12	2-05 👻	11:38:18	Only MS	Al Subscribe					1:33	Uner 16 Search
Brid Time		- a 1	12:31:31 2	Only Nodes	Altedet				3		
erch results											
atus: Roph	satory aff	ter 2011-12	2-05 11:38:18 loade	ed for MS [All Su	bsoribers] on N	iode [All nodes]				A-0.00	
4S		User No	MS Description	Timestz	np	Node	RSSI (dBm)	Distance(m)	Transceiver	Timeslot	Indicated in Message
1:00004:1	000393	1700123	Hare Dame 3 (11	EA1) 2011-1	2-05 14:52:35	N009-BSC1 Heruphav	-59	0	18.21	0	SDS data
38:00004:2	003109	2003109	Budstikken/9	2011-12	2-05 14:52:33	N025-BSC1 Borups Alle	-89	1040	TR11	0	Group call PTT change
38:00004:2	003120	2003120	Budstikken20	2011-12	2-05 14:52:31	N025-BSC1 Borups Alle	-75	+3130	78.11	٥	Group call PTT change
38:00004:2	003109	2003109	Budstikken8	2011-12	2-05 14:52:22	N025-BSC1 Borups Alle	-89	0	TRU	0	Group call PTT change
38:00004:0	000502	1700502	John Rosenberg	2011-1	1-05 14:52:18	N008-BSC1 Sanderborg Vendtilm	-80	1040	TR11	0	SDS data
38:00004:2	003102	2003102	Budstikken2	2011-12	2-05 14:52:17	N025-BSC1 Borups Alle	-76	0	TR11	0	Group call PTT change
38:00004:4	000101	1701901	TWC 2010 Sepur	e 1 2011-12	2-05 14:52:15	N008-BSC1 Sanderborg Vandtäm	-78	-1040	TREE	0	506 data
38:00004:3	000501	1700501	Mages Broderies	ni 20111-1	1-05 14-52 13	NOUR-BSC1 Sanderburg Vandtlim	-60	1040	THEE	0	SDS data
38:00004:2	012114	2012114	Dansk Kurer 14	2011-12	2-05 14:52:12	N005-BSC1 Brendby	-112	3130	TREE	0	MS location update
18:00004 2	001109	2003109	Rushtskiown/9	2011-0	2-05 14:52:11	ND75-RSC1 Romans Alle	-89	0	1811	0	Genuin call PTT change

Figure 3-106: Log Client, MS RSSI History

It is also possible to the approximately distance to the node and what Transceiver there was used for the call.

NB: MS RSSI history data older than 24 hours will be deleted in ver. 7.52



#### 3.7.10 Status View

The status view shows the latest received Status messages of the TetraFlex<sup>®</sup> Node. Each TetraFlex<sup>®</sup> node in the network reports its status on regular interval (default interval is 10 seconds). This means that the Status view should always have status messages no older than the interval.

On each status tab the nodes in the TetraFlex<sup>®</sup> network are listed including the reception timestamp of the TetrtaFlexLogServer and their latest status.

The Status tab gives an overview of the nodes and their status. Each Status generally has these states:

Status Table	
Status type	Description
OK	Everything in perfect order.
Warning [L1]	Level 1 warning, informational only.
Alarm [L2]	Level 2 Alarm, reduced functionality of component.
Blocked [L3]	Level 3 Blocking Alarm, dropout of component.
Start-up	The component is starting up.
Not Alive	The component is not responding.
[BLANK]	The component is not configured on this node.

The list can be refreshed manually by pressing Refresh.

#### 3.7.10.1 Status

The Status tab shown below gives an overview of the status window.

The view is essential the same as shown in the Network Management, so refer to the Network Management Manual for detailed description of the tabs

CRCU S				R					
Inedana	Decoption	Software version	Mode Status	Radio Shatus	Votox GW Status	PD GH Shikus	App. GM Statue	PSI Shitu	PS2 Status
009-02-24 13:05:06	S2003 Svavenaden	7.3= 2000-12-18	OE	OK.				OF.	OK:
1009-02-24 12:05:08	5000 Amagenventet	7.3x 2900-12-10	OK:	OK:				ÓK.	ICK.
2009-02-24 12:05:04	5000 H.C.@ubedeveriet	7.3x 2908-12-18	QK.	OK .				OF.	OK.
1009-02-24 13:05:00	5005 Drandby	7.3=2008-12-18	OK.	OK .				OF:	DK.
1009-02-24 13:09:00	5006 Sandarborg Vandslim	7.2+2908-12-18	OK.	OK .				OF.	OK:
1009-02-24 13:09:05	5009 Heruphev	7.3(2008-12-18	OE	OK .				OE	OK.
1009-00-24 13:05:00	5000 Senderborg GW3	7.3: 2908-12-18	OK		OF	OK:	OK .	OF.	OK .
0009-00-04 13:05 00	5000 Sanderborg TerriSeru/GH2	7.3+2908-12-18	OE		OK.	OK:	OK .	OF	OK.
009-02-24 15:09-06	SG25 borups Alle	7.3+2900-12-18	OK	OK.				OF.	OK:
009-02-24 12:05:06	3067 Votero	7.3x 2000-12-18	OK	OK.				OF	OK.

Figure 3-107: Log Client, Status view

#### 3.7.10.2 Common

On the Common tab it is possible to see the Repetition time interval, which the node uses for sending its status message.



#### 3.7.10.3 Subscriber

On the Subscriber Register tab it is possible to see which node is Master, and the subscriber counts and checksums which should be the same for all Nodes.

Status Katus Core Subscribe	non Subscriber Radio er Register	Status R	tadio Config 🛛 Voi	te Gi	PD	gw (	App G	w		_			_	_	_	
Vode /	Timestamp	Mode	Red. 85C	Org	Prof	Sub	551	User	p	Org Ck1	Org Cl/2	Prof Ck1	Prof Ck2	Sube Ck1	Sube Cit2	R-85C
01 (8901)	2009-02-24 13:09:14	Since	Stand-alone	0	17	287	287	243	15	0	0	3574050447	479037063	3214480205	1201810717	
82 (8901)	2009-02-24 13:09:17	Size	Stand-alone	0	17	287	287	240	15	0	0	3574058447	479037063	3214480205	1201810717	
13 (89C1)	2009-02-24 13:09:16	Size	Stand-alone	0	17	287	287	240	15	0	0	3574050447	479037063	3214480205	1201810717	
IS [89C1]	2009-02-24 13:09:17	Size	Stand-alone	0	17	287	287	240	15	0	0	3574050447	479037063	3214480205	1201810717	
18 [89C1]	2009-02-24 13:09:11	Sine	Stand-alone	0	17	287	287	240	15	a ↔	0	3574050447	479037063	3214480205	1201810717	
09 (85C1)	2009-02-24 13:09:12	Sine	Stand-alone	0	17	287	287	240	15	0	0	3574050447	479037063	3214480205	1201810717	
10 (8901)	2009-02-24 13:09:16	Master	Master	0	17	287	287	240	15	0	0	3574058447	479037063	3214480205	1201810717	BSC Alive
11 (8901)	2009-02-24 13:09:16	Sine	Stand-alone	0	17	287	287	240	15	0	0	3574058447	479037063	3214480205	1201810717	
25 [8501]	2009-02-24 13:09:15	Size	Stand-alone	0	17	287	287	243	15	0	0	3574058447	479037063	3214480205	1201810717	
97 [89C1]	2009-02-24 13:09:11	Size	Stand-alone	0	17	287	287	240	15	0	0	3574058447	479037063	3214480205	1201810717	
																Refree

Figure 3-108: Log Client, Status Subscriber Register

#### 3.7.10.4 Radio Status

On the Radio Status tab it is possible in real time to see active time slots.

Name and a	Texatorp	Status	2	3de	MCOt	\$004	ITCH	GTCH	PDCH	block.	Spare	Total	Tr 1 Status	Tr 2 Status	1+35hatua	Tr 4 Status	Tr 5 Status	Trid Status
001 [BSC1]	2009-02-24 13:10:08	OE.	0	6	1	0	0	1	a	0	0	8	OK.	OK .			2007-010	
obp [BSC1]	2909-02-24 10:10:09	OK.	0	6	I.	0	0	1	0	0	0	8	OK.	OK .				
000 [BSC1]	2009-02-24 13:10:13	OK.	0	6	0	0	0	1	0	0	0	8	OK.	QK.				
006 [BSC1]	2009-02-24 13:10:07	01	0	2	1.	0	0	0	0	0	0	8	06	OK .				
008 [BSC1]	2009-02-24 13 10:12	OK:	0		1	0	0	1	0	0	0	8	ÓK:	OK .				
000 [BSC1]	2009-02-24 12:10:14	OK	0	1	1	0	0	0	0	0	0	8	OK:	OK .				
025 [BSCI]	2009-02-24 13:10:06	OK.	0	6	1	a	8	1	υ.	8	0	8	OK .	OK .				
067 [BSCI]	2009-02-24 13:10:14	OK .	0	7	1	0		0	û.		D	8	OK:	QK.				

Figure 3-109: Log Client, Radio Status

#### 3.7.10.5 Radio Config

On the Radio Config tab it is possible see how frequencies are configured.

$\infty$	D	A	M	Μ
Damm Cellul	ar Syste	ems A/S	Denma	ark

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Hole	Tirestate	Satur	Active	MOCH	Proglaced	Offset	Duales Spaing	Reverse Operation		
001 [BSC1]	2009-02-04 13:10:07	ÖK.	Yes	1817	[144]	olee	1046-6	540		
102839300	809-82-24 13 12:08	OK.	Ves	1001	[144]	0848	1044-5	NN-		
oos(mocu)	2009-02-24 13 12:38	OE.	Vei	1032	[144]	ONTE	10991	Ma		
005 [8001]	2009-82-24 12:12:07	06	Ves	1834	{144}	00110	LOMPLE	file.		
008[8801]	2009-02-24 12:12:11	OK.	Yes	1121	[144]	OHE	1049-12	No		
009 [85C1]	2009-02-04 13112-09	OK.	res	1123	£1+43	OHE	1044-12	Mo		
oss (becu)	2009-02-24 12:12:11	0£	104	\$897	[144]	00102	1099-92	Mai		
062 [BBC1]	2009-02-24 13:12:10	06	Yee	609	(144)	0112	10991	No		
									P	
									Marco Carlo	

Figure 3-110: Log Client, Radio Config

#### 3.7.10.6 Voice GW

On the Voice GW tab the status for the Voice Gateway can be seen, including number of active and idle calls.

States				_		
status Cone	oot Selation Fack	State 18	ado Canfig	Vilo	PD SIN ADD DH	
Voice Ga	teway					
Hon .	Prestone	Status	A1910	Cels		
(conjunct)	1009-02-2412-15-12	08	0	14.5		
At Discil	2009-02-09 10 10:10	08	0	4		
						Getw

Figure 3-111: Log Client, Voice GW

#### 3.7.10.7 PD-GW

States				1
status Con	arat   Subatiliar   Fada	o Ratue   Radio Ca	Ng Yaakak PP NY Agalak	
Packet D	ata Gateway			
ilim (	Treastone	Statue		
eta (baca)	1009-02-24 13 13:56	CR.		
Ht [HCC]	3809-63-29 13:12/58	08		
			b.	
				Contract
				1 HOUSE

Figure 3-112: Log Client, Status Packet Data GW

# 3.7.10.8 App-GW

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() States			2
Rania   Conson   Salar Bar   Facto Rania   Rado Config   Year DA   Pb Car   A Application Gateway	4 3W		
Biology         Status           000000000000000000000000000000000000			
De .			
		C	Rotrat

Figure 3-113: Log Client. Status App GW

# 3.7.11 Settings View

The Settings view has six sections: Database, nodes, subscriber, sound, logserver licenses and log server config.

# 3.7.11.1 Database

Database settings used by the TetraFlex<sup>®</sup> Log Client is shown.

It is possible to replace SQL Server by specifying the IP address and login credentials. By pressing the **Connect to Database!** Button the client establishes the connection to the SQL Server and database specified. This can be done on the fly.

The **Reload Database Settings**- and **Save Database Settings** respectively load and save the database settings to a local file Log Client.ini located in the same folder as the Log Client executable.

In the maintenance section it is possible to setup backup and cleanup intervals (please see the section 3.6.3 Log Server Maintenance)

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Settings				×
Database Nod	es Subscriber Sound LogServer Lice	enses LogServer Config	g	
Databage Set	tings (Client)			
SQL Server	10.239.16.200	Database Name	TetraFlexLogDB	
Login	root	Password	••••	
	C	Connect ! Re	eload Settings Save Settings	
Database Ma Enable Next scher Start maint	intenance scheduled maintenance duled maintenance task: 2011-12-09 22 enance at 00:00:00 🛟	:00:00 Maintenance interval	Weekly	
Backup ne	o database twork share (accessible from LogServer)	m\Support\John\Tetra	aStar_Logserver_Backup Browse	
Cleanu Delete rece	p database records (after backup)			
	Maintenance Now Mainten	nance History) Re	eload Settings Save Settings	

Figure 3-114: Log Client, Settings database

# 3.7.11.2 Nodes

Node descriptions and last status received information

- If a node has managed to send status messages prior to the node being configured with the correct node number etc. the node may be deleted here and will reappear with the correct settings at the next status message (10 sec.)
- A deleted node will be removed from node status and node statistics views and database.

000	D	A	M	M
Damm Cellul	ar Syste	ems A/S	Denm	ark

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😒 Settings 📃			
Database Nodes Subscriber Sound	LogServe	r Licenses LogServer Config	
Description 🛆	Node	Last Status Received	
N001-BSC1 Svanemøllen	001	2011-12-05 13:38:16	
N002-BSC1 Amagerværket	002	2011-12-05 13:38:18	
N003-BSC1 H.C.Ørstedsværket	003	2011-12-05 13:38:16	
N004-BSC1 Københavns Lufthavn	004	2011-12-05 13:38:17	
N005-BSC1 Brøndby	005	2011-12-05 13:38:19	
N006-BSC1 Bella Center	006	2011-12-05 13:38:21	
N008-BSC1 Sønderborg Vandtårn	008	2011-12-05 13:38:13	
N009-BSC1 Høruphav	009	2011-12-05 13:38:20	
N010-BSC1 Sønderborg GW1	010	2011-12-05 13:38:16	
S000 Sønderborg TermServ/GW2	011	2011-12-05 13:38:20	
N012-BSC1 Hua Hin, Thailand	012	2011-12-01 23:13:42	
N013-BSC1 Term GW1	013	2011-12-05 13:38:19	
N015-Sønderborg GW3 DMZ	015	2011-12-05 13:38:14	
N025-BSC1 Borups Alle	025	2011-12-05 13:38:14	
N062-BSC1 Skærbækværket	062	2011-12-05 13:38:18	
N101-BSC1 Node Server 1	101	2011-12-05 13:38:20	
		Refresh Delete	

Doc No

Figure 3-115: Log Client, Node information

# 3.7.11.3 Subscriber

The configured subscribers are listed. The list is a positive list, meaning that subscribers not in the list will be treated as subscribers with Voice- and Location Logging disabled.

NOTE: In case the Log Server settings has a selection "Log all MS by default", then subscribers which has NOT been added to the list will be voice and location logged

The Voice Logging Priority only applies to the subscribers where Voice Logging is enabled. In this view it is possible to add, edit, or delete subscribers.

Note that the LogServer hardware Dongle settings can override the Voice- and Location Logging settings.

Note Voice Logging:

For individual calls the following rule applies: If either the calling or the called party is on the positive list, the call is voice logged otherwise not.

For group calls the following rule applies: If the called group TSI appears in the positive list, then the group call is voice logged otherwise not.

If all voice logging channels are occupied (number of voice logging channels is defined by LogServer dongle), then the priority is used to interrupt and stop voice logging for lower priority calls. If no voice logging channel is free when a new call is established, then the lowest priority ongoing voice logged channel is freed for the new higher priority call.
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Settings						
Database Nodes S	ubscriber Sour	d LogServer L	icenses LogSer	rver Config		
Description 🛆	SSI	MCC	MNC	User No	Voice logging enabled	^
Haderslev Kraft	2008001	238	4	2008001	Yes	
Haderslev Kraft	2008002	238	4	2008002	Yes	
etakeaway Grp1	2009001	238	4	2009001	Yes	
etakeway9	2009109	238	4	2009109	Yes	
Dansk Kurer Grp 1	2012001	238	4	2012001	Yes	
Zonith Test Grp 1	2998091	238	4	2998091	Refresh	
Zonith Test Grp 2	2998092	238	4	2998092	Yes	
Skærbæk Grp 1	3002000	238	4	3002000	Yes	
Skærbæk Grp 2	3002001	238	4	3002001	Yes	
Skærbæk Grp 3	3002002	238	4	3002002	Yes	
Skærbæk Grp 4	3002003	238	4	3002003	Yes	
Skærbæk Grp 5	3002004	238	4	3002005	Yes	
Skærbæk Grp 6	3002005	238	4	3002006	Yes	
TWC 2010 Sepur	12917090	238	4	1701108	Yes	
						~
<					>	
			Refn	esh Add N	lew Edit Delete	
	F	igure 3-116.	Log Client	Subscriber I	ist	

# 3.7.11.4 Sound

This setting are for the voice recording playback

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Settings					
Database Nodes	Subscriber So	ound LogServer Licenses	LogServer Config	U	
-Sound Settings					
Select output so	und device				
SRS Premium S	ound			*	Test Sound
- Temporary Sour	id Files				
Enter path for ter	moorary playback	files			
C:\Documents a	and Settings\ir\Te	etra\LogClient\10.239.16.2	00\Temp\Wav Files		Browse
	ine counigo ji me				
					Delete temp files
			Reload Soun	d Settings Sav	ve Sound Settings

Figure 3-117: Log Client, Sound settings

- Sound Settings Setup and test of output sound device
- Temporary Sound Files:
  - Setup, save/reload and deletion of the path to the temporary sound files saved whenever a CDR is played
  - Standard setting %USERPROFILE%\Tetra\LogClient\<LogServer name>\Wav Files

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## 3.7.11.5 LogServer Licens

License dongle information shows the license dongle settings for the Log Server

Database Nodes Subscriber	Sound LogServer Lic	enses LogServer Config
Las Casura Liannas Danala Infa		
LogServer License Dongle Infol	mation	
Dongle serial number:		08000613
Dongle date limit:		No limit
Application date limit:		20300101
SDS content logging:	2	Allowed
CDR and MS location logging:	5	Allowed
Max number of concurrent voic	e logging channels:	64



# 3.7.11.6 LogServer Config

This shows how the log server is configured. It is not possible to make changes to the settings from here. Please see the chapter 2.10.3 for setting the parameters.

				1.00	2011-12-00
Damm Cellular Systems A/S, Denmark	TETRAFLEX®	V7.5 I	MANUAL -	TetraFlex®	Log Client
R-M					
, settings					
Database Nodes Subscriber Sound LogSer	ver Licenses LogSe	ver Co	nfig		
<					
LogSever description	TetraStar LogServe	r N010			
LogServer no	10				
Multicast status IP (sending)	224.239.016.001	Port	42400		
LogServer multicast control IP (receiving)	224.239.017.001	Port	42402		
Multicast voice		Port	42396		
Manual select of LogServer IPs: LAN IP	172.016.000.010				
WAN IP	010.239.016.200				
☑ Log all MS by default					
Enable CDB and MS longing					
Enable voice logging	ent voice logging ch	annels:	32		
	en voice logging en	anneia.	32		

#### Figure 3-119: LogServer config

Log Server Settings may be overruled by the dongle configuration. Logging selection may be set equal or less than the settings in the license dongle. As an example license dongle settings gives privilege to do SDS Content Logging (=Allowed) but if the flag "Enable SDS Logging" is not set, the SDS content is not logged, i.e. log server settings overrules dongle settings.



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# PART-4: Technical References



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# 4.1 ANTENNA SYSTEM FOR BS41x

4.1.1 Introduction

This application note describes the recommended antenna configuration for the BS41x Tetra Base station.

The BS41x Tetra BS includes either the TMA412 Tower Mounted Amplifier or the TMD412 Tower Mounted Amplifier and Duplexer. The use of the RX amplifier section in the TMA/TMD is mandatory. It shall preferably be mounted in the top of the mast as close as possible to the RX antennas or alternatively ground mounted at the BS rack.

The TMD412 in addition contains a Duplex Filter, which optionally can combine the TX and one RX to run on same antenna.

Whenever possible it is however recommended to run with two separate RX antennas and one TX antenna.

When using the TMD412 Tower Mounted Amplifier/Duplexer it is recommended not to use the duplex filter option for more than 1 carrier, as the usage of the duplex filter may increase disturbances in the receiver i.e. reduced sensitivity. When using the duplex filter option, care shall be taken not to use TX frequencies generating 5th order IM products on the used RX frequencies

The antenna system shall in addition contain one GPS antennas for each installed BSC.



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# 4.1.2 Typical antenna configuration

The drawing below shows a typical antenna arrangement for a base station. If the duplexer is used it combines the RX-A and TX feeder to e single antenna. The feeder system from the BS to the top of the mast is the same for both cases.



# 4.1.2.1 TMA412/TMD412

A block diagram of the TMD412 is shown below. The TMA412 is identical except for the omitted Duplexer.



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# 4.1.2.2 RX antenna

The BS uses two receiver antennas for its dual RX diversity implementation. The TMA is provided with a dual tower-mounted amplifier with input filters, amplifiers and test circuits for measurements. The BS includes all the required circuitry to supply the two amplifiers with DC power and to control the test circuit through the feeders.

The two RX antennas should be mounted as widely spaced as possible to optimize the gain of the diversity reception. In addition they should be mounted to have a coupling with the TX



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antenna of >30dB to ensure proper operation. The TX separation is normally achieved without much effort.

Three identical low-cost feeders are required for the RX antenna system. As the main RX filters are located in the TMA, cables with good screening are needed to avoid radiation into the cables. Cables should either be double shielded or with solid screen. For most applications ¼ inch corrugated cables is the optimum choice. Cables of type RG58/U and RG213/U should not be used.

The TMA has a nominal gain of 15 dB and the system is designed to have a nominal total gain from TMA input to BS RX connector input of +6dB. With some margins this allows a maximum feeder loss of 8dB. Attenuators are provided in the BS to adjust the total gain. Note that use of lower-loss cables will not improve system performance, just increase the cost.

The following table indicates the maximum allowed length of different possible cable types:

Cable with 8dB loss	450MHz	850MHz
RG223/U	28m	19m
RG214/U	50m	35m
1/4 inch (RFS CF14-50)	85m	60m
3/8 inch (RFS LC38F-50)	105m	75m
1/2 inch (RFS LCF12-50)	170m	120m
5/8 inch (RFS LCF58-50)	220m	155m

If very thick cables are used, jumper feeders in both ends may be needed. Cables and connectors between antenna and TMA412/TMD412 shall be resistance to water ingress and migration.

# 4.1.2.3 TX antenna

The BS uses a TX antenna for all the installed TETRA carrier units, which may optionally also be used for receiving. All components used in the TX antenna system need to be high quality components with low inter-modulation to avoid distortion product to jam the receiver inputs. The requirements include the TX antenna itself and also the feeders and connectors.

The TX antenna feeder should be provided with connectors of type 7/16. Other connector types should be avoided, including connectors of type N. For 2-carrier only base stations without Duplexer N-type connectors can be used at antenna and BS.

The feeder cables shall have as low as possible insertion loss and have a solid screen. Cables with woven shields of thin wires should never be used.

The TX cable loss can be compensated, by increasing the TX output power to balance the system requirements. For a low-power Base Station this can be an acceptable solution but for a high-power BS this can give an unacceptable increase in the mains power consumption or may not be possible at all.

As guideline, the TX antenna feeder loss for a high-power BS should not exceed 2dB. This can be achieved when not exceeding the following cable lengths:



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Cable 2dB loss	450MHz	850MHz
1/4 inch (RFS CF14-50)	21m	15m
3/8 inch (RFS LC38F-50)	27m	19m
1/2 inch (RFS LCF12-50)	42m	30m
5/8 inch (RFS LCF58-50)	55m	39m
1 1/4 inch (RFS LCF114-50)	93m	65m
1 5/8 inch (RFS LCF158-50)	128m	88m

For normal installations 5/8 inch cables or thicker is recommended. When thick cables are used it is normal needed to have jumper cables in both ends to avoid stress to the connectors on the antenna and BS.

Cables and connectors between antenna and TMD412/BS41x shall be resistance to water ingress and migration.

# 4.1.3 GPS antenna

Each Base Station Controller includes a GPS receiver, which requires an antenna. The GPS antenna connector delivers +5V for an antenna with built-in amplifier. The GPS antenna should preferably be mounted on top of the building with good all round vision the whole horizon. It should NOT be mounted in top of a high mast and should be kept at the greatest possible distance from any transmit antenna.

The GPS signal is received on 1575.42 MHz with a bandwidth of a little more than 2 MHz Special care with separation from the TX antenna is important especially, if any transmitter is located in the range 393.5-394.2 MHz (4<sup>th</sup> harmonic). The current used GPS receiver module in the BSC411 is a Motorola M12 and in BSC412 it is an iTrax.

Several manufactures have appropriate antennas, which match the receiver. An example is shown below.



The GPS antenna shall include an amplifier with a gain of about 25dB. As a guideline the cable loss should not exceed 14 dB, which gives the following maximum cable lengths:

Cable type	14dB
RG223/U	23m
RG214/U	46m
1/4 inch (RFS CF14-50)	70m



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Cables and connectors between antenna and BS41x shall be resistance to water ingress and migration.

#### 4.1.4 TX inter-modulation considerations

One of the most critical aspects about antenna systems for a multi-carrier base station is to control the inter-modulation generated between the different transmitters in the BS.

Inter-modulation happens in many different places on different levels. One major place is the TX output amplifier itself. When a signal from another TX reaches a TX output amplifier, all typical transmitters will generate 3<sup>rd</sup> order IM products with a level typically 15dB below the interfering signal. The BS41x Base Station is provided with double circulators in the TX output to make sure, that IM3 products close in frequency will be at least 70dB below the carrier.

At greater differences in frequency the inter-modulation products are further reduced by the selectivity of the TX cavity combiner and the TX output filter. In the RX frequency band of the BS spurious and 5<sup>th</sup>-order IM products measured at the TX antenna connector are verified to be less that –106dBm. With the expected RX-TX antenna separation of 30 dB, any generated product in the receiver input will be less than –136dBm, well below the RX sensitivity level. This verification has been done with up to 16 simultaneous transmitters of 50W each.

For carrier output of 20W (+43dBm) the –106dBm gives a rejection of –149dB. To reach this level, extreme care is needed to avoid inter-modulation at any point.

Some connector manufacturers have recently started to specify 2-tone 3<sup>rd</sup>-order IM for their high quality connectors. These specifications typically is about –150dB. IM with more than 2 carriers are not specified. It is recommended only to use DIN 7/16mm connectors in the TX antenna feeder section. N-connectors are an order of magnitude worse and should never be used for more than 2 carriers.

Feeders shall be with solid screen and inner conductors to avoid any possibility for unlinearity due to undefined connections between individual cores in the cable. High quality RG214/U cable has been demonstrated to produce noise when bent mechanically in the lab, simulating a windy condition on a mast.

The larger antenna vendors have in the last years established test set-ups to verify IM properties of their cellular antennas for 900 and 1800MHz. For 400MHz this is almost non-existent. It is recommended that if a tested antenna cannot be purchased, then ask the vendor to confirm that all construction principles are identical to those used in verified antennas in the 900 or 1800 MHz range.

One very critical thing to remember about inter-modulation is, that it is very difficult to predict accurately. For antenna constructions two factors heavily degrade the performance. Over years connectors etc. starts to corrode, degrading IM. Additionally, IM properties can also degrade under windy conditions. Therefore a short verification of a new antenna set-up after installation does not guarantee performance in the longer term.



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Inter-modulation can be calculated with the formulas:

$$3^{rd}$$
: f = 2xf1 - f2  
 $5^{th}$ : f = 3xf1 - 2xf2  
 $7^{th}$ : f = 4xf1 - 3xf2

RX frequencies should never be selected to be on frequencies, where 3<sup>rd</sup>-order IM is present for high-power Base Stations. However, 3<sup>rd</sup> order IM is only possible with special Base Stations with a TX frequency separation larger than the guard-band between RX and TX bands.

For high power Base Stations running with Duplex Filter, 5<sup>th</sup> order should always be avoided, and 7<sup>th</sup>-order should preferably be avoided as well.

The BS41x is provided with an RSSI indication accurate down the RX noise floor. This can be easily used to check for disturbance from the transmitters.

First, display the RSSI for all carriers with the OM command:

## B/21/1

Note the actual RSSI and the try to key all the transmitters simultaneously with the command:

#### B/10+

Check the RSSI again. The difference in RSSI indicates directly the reduction in sensitivity due to disturbance from the Transmitters.



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# 4.2 TX COMBINER FOR BS41x

# 4.2.1 Introduction

The BS41x Tetra Radio Base Stations are provided with a TX combiner system to combine all the installed transmitters to a single antenna.

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The combiner system has the following requirements:

- Combine the transmitters to a single feeder with lowest possible insertion loss.
- Give isolation between the TX input ports to avoid the signal from one transmitter to reach the other transmitters and generate inter-modulation. The isolation requirement is normally minimum 55dB in order to reach a suppression of the intermodulation signals of 70dB relative to the individual carriers.
- Filter the TX antenna output to reduce any unwanted signal in the receiver band of the Base Station to be less than –106dBm in order to avoid interference in the receiver with an TX/RX antenna separation of >=30dB.
- Make wide-band filtering of the TX output signal to avoid interference to other radio equipment installed in the same mast.

Two different methods exist in order to combine several transmitters to a single antenna:

- Cavity Combiner (combining with filters)
- Hybrid Combiner (combining with 3-dB couplers)

The cavity combiner has the advantage that it can combine a high number of transmitters selectively with almost constant insertion loss independent of the number of transmitters used. The disadvantage of the Cavity Combiner is that it requires minimum frequency spacing between each individual transmitter of minimum 175 kHz for the 400MHz band and 250 kHz for the 800MHz band.

The Hybrid Combiner has the advantage that is can combine transmitters with no frequency spacing restrictions and without any adjustment. For a 2-way Hybrid Combiner the insertion loss is almost equal to a Cavity Combiner. However to combine more transmitters the insertion loss increases rapidly. The theoretical insertion loss for a 2-way hybrid is 3dB, for a 4-way hybrid 6dB and for an 8-way hybrid 9dB.

The BS412 2-carrier BS is provided with a hybrid combiner whereas the BS411 and BS414 as standard are provided with cavity combiners. The BS414 can however also be delivered with a 4-way hybrid combiner.

#### 4.2.2 Cavity combiner system

The Cavity combiner system consists of the TC411 TX Combiner 4-way module and the TF411 TX Filter. Kits with junction and connection cables connects the units together.



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The schematics of the cavity combining system are shown below:



#### 4.2.2.1 Circulator

The TX output signals come from the TR41x to the TC411 in cables attached to the Cassettes. In the TC411 it first passes a dual circulator, which gives a reverse isolation of at least 50dB.

A circulator is a very special device with different insertion loss in the two directions. It is a passive but non-linear device, which do not follow Ohm's law.

A circulator is a 3-port device, which behaves as a turn-around with the rule, that when you enter a port you follow the direction of the arrow around and leave the first-coming outlet again.

The function of a dual circulator is shown on the drawing below:

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The TX signal enters the port on the lower circulator and follows the green line. It enters the first circulator, follows the arrow and leaves it again in the first-coming port. The same happens in the second circulator. The TX signal passes the circulator with an insertion loss of around 0.5dB.

Any signal entering the upper port in the reverse direction will follow the red line. This could be the transmitter signal reflected at the cavity filter or at the antenna, or a signal from another transmitter.

Most of the reverse signal will be dissipated in the big high-power resistor connected to the first port. A diode detector connected to the resistor makes it possible to monitor the size of the reverse signal.

Some of the signal will be reflected at the high-power resistor and follow the red line to the low-power resistor on the next circulator, where most of the remaining signal will be dissipated. However a small fraction will be reflected and end up at the TX input port. The total rejection in the reverse direction will normally be higher than 50dB.

The size of the reverse signal can be monitored either by a voltmeter attached directly to the Test Point or via the O&M interface and the TR41x or the TCC411. The test point is used for adjustment of manually tuned combiners. The TR41x will also monitor the level on the TP and generate an alarm if the reverse signal becomes too high.

Note, that when the Base Station runs without antenna or with the cavity filter tuned to a wrong frequency, all the reflected power ends up in the high power resistor, which is designed to dissipate the total transmitted power continuously. The PA of the TR41x will always look into a perfect load as long as the cable is correctly connected between the TR41x and the circulator.

# 4.2.2.2 Cavity Filter

From the Circulator the TX signal enters the Cavity filter to combine the TX signals selectively. For the 400MHz range the cavity is a ¼ lambda TEM resonator with an unloaded Q of about 10.000. For the 800MHz range the cavity is a ¾ lambda TEM resonator with an unloaded Q of about 13.000.

The cavity is fully temperature compensated, and is tuned to the center frequency of the transmitter either automatically with a stepper motor or optionally manually by hand.

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The TC411 module contains 4 cavity filters, which are internally combined together with a 4way ¼-lambda junction, which transforms the short circuit of the cavity at out-of-band frequencies to open circuit at the junction point.

4.2.2.3 Junction cables

The TC411 combiner module can either be connected directly to the TF411 filter or expanded with junction cables to 8 channels (optionally up to 16 channels). The junction cables are ½-lambda (or multiply thereof) long in order to keep the high impedance for all out-band frequencies in all junction points.

The junction cables are manufactured with extremely high precision and measured individually for electrical length. Never try to create these cables on your own.

# 4.2.2.4 Filter connection cable

The combiner output from the junction point is connected to the TF411 TX output filter with a cable with a specific electrical length. The electrical length is important for out-band frequencies due to the serial connection of two filters.

#### 4.2.2.5 TX output filter

The TF411 high-power TX output filter gives an additional rejection of the TX noise of 25dB in the RX frequency band, which together with the cavity filters gives a total RX band rejection of 60dB minimum.

The output connector of the filter is a DIN 7/16mm connector with good inter-modulation properties.

The filter output also contains two directional couplers with BNC connectors with an accurately adjusted coupling of -40dB and a directivity of minimum 25dB.



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## 4.2.2.6 Power measurement

The outputs of the two directional couplers are connected with BNC cables to the rear of AI411, which contains two precision RMS detectors to convert the actual power into DC current.

The current outputs are forwarded to the BSC412 Base Station Controller, which can display the actual output and reflected power at the TX antenna connector.

The following OM commands can be used to check the output

F15/F (output and freq for each running TR412) F13 (summarized output after combiner)

The Al411 is provided with two adjustments on the front plate, to allow accurate calibration of the displayed power.

# 4.2.2.7 TCC411 TX Combiner Controller

The TC411 Cavity Combiner is equipped with the TCC411 TX Combiner Controller, which controls the position of the stepper motors based on channel information received from the TR41x Transceiver.

At power-up the Micro-Controller tunes the cavity to the upper mechanical end stop to know its exact position.

When receiving a channel command from the TR41x the MC calculates the required motor position and automatically tunes the cavity to the required position. The required motor position is calculated from a calibration table inside the MC, created when the TC411 is factory adjusted.

The channel command to the TCC411 is automatically generated in the TR41x when a channel change is done.

If the TR41x is powered off or removed, the TCC411 will automatically after about 30 seconds in brackets return the cavity to the upper end stop to avoid it to interference with other cavities.

The TCC411 is provided with an O&M interface and can be accessed from the BSC411.

The center frequency of the cavity can be fine adjusted with the 13 command in the TCC411. This is normally not needed but could be done if e.g. the BS is placed at a high altitude, where the air pressure is lower, which will increase the cavity frequency.



## 4.2.3 BS414 4-way Hybrid Combiner system

The BS414 can optionally be fitted with a 4-way Hybrid Combiner module instead of the Cavity Combiner. To compensate for the missing filtering in the cavity the TF411 is replaced with the TF412 60dB TX Filter.



The TH414 consists of four dual circulators followed of a 3-dB Wilkinson combining tree giving a theoretical insertion loss of 6dB.





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# 4.3 **RX MULTI COUPLER FOR BS41**X

## 4.3.1 Introduction

The purpose of the RX multi-coupler system is to distribute signals from the RX antennas to the RX inputs of the TR41x Transceiver.

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The Base Station is provided with two completely independent RX signal paths to connect the two RX antennas.

The use of two RX antennas in a diversity scheme gives a considerably improvement in sensitivity of the Base Station. The improvement is described in the Diversity Application Note.

In addition the use of two RX antennas with completely separate signal paths gives redundancy to the BS RX. If a fault occur in one leg of any of the components (antenna, feeder, amplifier etc.), the BS will still be able to operate with the other antenna, only loosing the sensitivity of the diversity gain.

The system includes as standard a Tower Mounted Amplifier to eliminate the sensitivity degradation normally caused of the RX feeder loss. The TMA can compensate for up to 8dB feeder loss with no change in RX sensitivity, allowing the use of thin feeders with a considerably saving in feeder expenses. See the Antenna application note for antenna and feeder configurations.

The Base Station is provided with an RF Test Loop feature, which allows a transmitter to generate a test signal for test of the complete RX section, including measurement of RX sensitivity at the TMA input and measurement of RX antenna return loss.

Dependent of the type of Base Station used, up to 16 TR41x can be connected to a single Radio Cell, and up to 4 Radio Cells can be configured in a BSC411 Base Station Controller.

#### 4.3.2 RX signal path description

The RX signal normally comes from the RX antenna to the TMA input with a short jumper cable. The TMA is provided with an N-female connector.

Inside the TMA the signal first passes a dual directional coupler used to insert test signals in forward and reverse directions. This feature is described in the RFTL section. The signal then passes a big low-loss pre-selection filter. The input of the filter is DC grounded to ensure that no DC voltage can be build-up on the antenna feeder. The filter has the following specifications:

Parameter	400MHz	800MHz
Pass-band width	5MHz	14MHz
Guard-band width	5MHz	25MHz
Out-band rejection	60dB min.	60dB min.

The high 60dB out-band rejection ensures proper duplex operation of the Base Station. With the required RX-TX antenna isolation of 30dB a total rejection of the TX signal of 90dB is



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obtained before reaching the first amplifier. The filter also ensures good rejection of signals from other transmitters in the same mast.

The filter is followed of an LNA with a GaAs PHEMT transistor with simultaneous very low noise figure and high IM intercept point.

The amplifier output goes to the N-female output connector, where the DC-feed from the BS to supply the amplifier is extracted. An over-voltage arrestor is provided on the connector to protect the amplifier during lightning.

The RX signal is then going from the TMA to the RX input connector on top of the BS through the RX feeder, and further internally in the BS to the RM input of rear side of the Al411 Antenna Interface Unit.

The Al411 input is also provided with an over-voltage arrestor. After passing the DC insertion circuit, the RX signal passes a directional coupler, which can be used to provide a test input signal through the TNC connector on the Al411 front plate.

Afterwards follows the attenuator used to balance the RX feeder loss, adjustable through the hole in the front plate marked "Gain".

The signal is amplified in a low-noise high dynamic range transistor to compensate for the following splitters. The Al411 is provided with two outputs coming from a 2-way Wilkinson splitter.

The two outputs can either feed up to eight TR41x through external splitters with 13dB insertion loss (used in 4- and 8-carrier BS versions) or feed two TR41x directly (used in the 2-carrier BS version).

A jumper internally in the AI411 changes the output level with 13 dB to compensate for the splitter. The actual setting of this jumper is marked outside the AI411 besides the type plate.

#### 4.3.3 Supply and alarm circuits

Each RX path is provided with independent voltage regulators to feed the TMA and RM amplifiers.

The TMA DC feed is provided with circuitry to detect low-current alarm (no TMA connection) and low-voltage (TMA connection short-circuit).

Similarly the RM amplifier is provided with circuitry to detect low-current and high-current alarms.

The alarms are connected to the BSC and send to the TR41x's assigned to the particular Radio Cell. If faults exist in one leg only, a warning alarm is generated. If alarms exist in both legs, a blocking alarm is generated.

#### 4.3.4 RF Test Loop path description



The Base Station is provided with an RF Test Loop feature allowing extensive test of the whole Base Station both locally and remotely without any additional equipment.

Each TR41x is provided with an RFTL output (BNC connector) on the front plate. The output can be activated with either a high level output (-40dB relative to the TX output connector), low level output (-50dBr) or turned off (<-80dBr).

The output signals are either combined in RFTL combiner modules and brought to the Al411 RFTL inputs (4- and 8-carrier versions) or brought directly to the Al411 inputs (2-carrier versions).

In the AI411 the two inputs are combined, followed of and attenuator/jumper to compensate for the loss of the external combiner. This setting always follows the similar settings in the RM.

Afterwards follows a variable attenuator adjustable through the AI411 front hole marked IN. This attenuator is used to compensate for output power selection of the TR41x.

The signal now enters a double balanced mixer, where the frequency is converted from the TX band to the RX band. A Crystal oscillator running on the RX/TX duplex frequency offset provides the injection signal.

The mixer is followed of a HPF and a buffer amplifier before it reaches the variable output attenuator, accessible from the front of the Al411 through the hole marked OUT. This attenuator is used to compensate for actual cable loss of the TEST feeder going to the TMA.

A combining circuit at the output connector allows the insertion of an external test signal from the BNC connector on the AI411 front plate marked TEST IN.

At the output connector a DC control signal insertion circuit is provided to the TMA, together with an over-voltage arrestor.

From the TNC output connector on the rear of the Al411 the test signal is connected internally in the BS to the N-female TEST connector on the BS top, from where it goes to the TMA in the top of the mast with a feeder similar to the RX feeders.

The TEST input in the TMA is also provided with an over-voltage arrestor and a DC separation circuit.

In the TMA the test signal is divided in two, one for the A-path and one for the B-path. The test signal is then inserted in either the forward direction of the two paths to the BS (-50dBr) or optionally in the reverse direction against the antennas (-40dBr).

The direction is controlled of the DC signal in the TEST feeder and reverse direction can be activated of each of the TR41x, when RX antenna return loss measurement is performed.



# 4.4 TR412 TRANSCEIVER DESCRIPTION

## 4.4.1 Introduction

The TR412 Transceiver is a complete Tetra Carrier Unit containing a dual diversity receiver, a highly linear transmitter and all the necessary computer power to handle the lower protocols and control functions. The TR412 is an upgraded plug-in replacement for the TR411.

The TR412 is able to run different modulation and protocol types depending on the actual software running on the DSP and controller. The standard TETRA version also support analogue PM modulation for testing purposes, to allow complete testing of a site with analogue test equipment.

#### 4.4.2 Receiver

The receiver contains two completely independent signal paths for dual diversity reception as standard.

Each RX signal comes from the Receiver Multi-coupler system into the TR412 via the TNC connector on the front plate, and is amplified with about 17dB in the RF amplifier, followed of a 3-pole BPF.

The signal now enters 1<sup>st</sup> mixer, where it is converted down to 1<sup>st</sup> IF of 45MHz. 1<sup>st</sup> mixer is a high-level double balanced mixer running with an injection level of +17dBm to obtain a high dynamic range.

The 1<sup>st</sup> mixer is followed of a 4-pole 45MHz crystal filter, an IF amplifier with about 30dB gain and a second 2-pole crystal filter. The crystal filters are of linear phase type to avoid distortion of the digital modulation.

From the output of the second crystal filter the signal enters 2<sup>nd</sup> mixer, where it is converted down to 2<sup>nd</sup> IF of 144kHz. The signal is then amplified and balanced with op-amps before it goes from the RX Front End Board to the Main Board, where it is converted to digital.

The ADC samples the 2<sup>nd</sup> IF signal of 144kHz directly with a sampling frequency of 576kHz and a resolution of 16bit. The digital signal is going to the DSP on a serial interface.

In the DSP the signal is first down-converted to base-band and is then passing the channel definition filter, which determines the actual bandwidth of the receiver. In TETRA mode the filter is the root-raised cosine filter.

Afterwards frame synchronization, diversity combination and demodulation takes place.

The Local Oscillators for the RX is generated on the RX FS board, locked to a 12.8MHz reference coming from the Main Board.

1<sup>st</sup> LO is a Voltage Controlled Oscillator running either 45MHz below or above the actual receiver frequency. The VCO is phase locked to the 12.8MHz reference with a fractional-N



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PLL circuit, controlled through a serial interface from the Micro-Controller. The VCO signal is amplified to about +23dBm and brought to the RX Front End via the attached cable. Here it is first filtered in a 3-pole ceramic filter before it is split into two +17dBm injection signals for the two 1<sup>st</sup> mixers.

 $2^{nd}$  LO is a Voltage Controlled X-tal Oscillator running on 44.856MHz and this is also phaselocked to the 12.8MHz reference. The signal is amplifier to about +13dBm and brought in another cable to the RX Front End, where it is split into two +7dBm injection signals for the two  $2^{nd}$  mixers.

## 4.4.3 Transmitter

The transmitter of the TR412 is build around a Cartesian loop to meet the demanding TETRA linearity requirements. The TX signal is generated directly on the transmit frequency to optimize spurious and wide-band noise performance. The transmitter is able to deliver 60Wpep at the output connector of the TR412, equal to 25W TETRA.

The carrier frequency is generated of a Voltage Controlled Oscillator on the actual TX frequency. The VCO is phase locked to the 12.8MHz reference coming from the Main Board with a fractional-N PLL controlled through a serial interface from the MC. The VCO is running independent of whether the TX is keyed.

The output signal from the VCO is amplified to about +23dBm and split into two signals, a +11dBm signal for the I/Q modulator in the forward leg and a +21dBm signal for the I/Q demodulator in the feedback leg.

The I/Q modulation signals are generated directly of the DSP and send on a serial interface to the dual 16-bit DAC with associated low pass filters. The I/Q signals acts as reference signals for the Cartesian feed-back loop.

After the comparator comes a variable phase circuitry to adjust for the Cartesian loop phase and the loop filter before the modulation is applied to the I/Q modulator. A linear amplifier increases the output level from the Exciter to +14dBm pep.

The Power Amplifier consists of one LDMOS driver and one output transistor, delivering 60W pep output power with good linearity. An attenuator in the input is used to fine adjust the total gain of the Power Amplifier. Both transistors are running in class AB for an optimum compromise between linearity and efficiency and are supplied with +26V DC.

After the PA four directional couplers are provided. A forward and a reverse coupler are used for the Power Meter to allow the display of forward and reflected power. One directional coupler is used to sample the output signal for the RFTL switch, and the last directional coupler is used to take a sample of the output signal for the Cartesian loop feedback.

The feedback signal is brought back to the Exciter in a thin cable. After passing an attenuator to adjust the level it enters the I/Q demodulator, where the signal is converted back to baseband. After the base-band feedback amplifier the signal is compared with the I/Q modulation reference signal from the two DAC.



Running with a DSB signal with 60W pep the forward leg IM3 of about 30dBc. The linearity is improved with the loop gain of about 40dB to reach the Adjacent Channel Power specification for TETRA of 60dB with good margin.

Hardware and software support is provided for open-loop operation with different modulation types to allow easy adjustment and test of the transmitter.

A dual RMS power detector is provided on the main board to permit the read-out of forward and reflected power from the controller as well as for alarm monitoring.

At the TX output the RF Test Loop switch unit is provided with a BNC connector on the front plate. This allows the controller to activate a test output from the TX with an accurately calibrated level of –40dBr and –50dBr relative to the TX output. In off state the maximum level of –80dBr.

#### 4.4.4 Reference oscillators

The TR412 is normally running fully frequency and time synchronized with the BSC. The synchronization is done with the 2.048MHz, the 8kHz and the 1sec. hardware signals and the 1 sec. HDLC message, all coming from the BSC.

The TR412 contains a 12.8MHz VCXO, which is phase locked to the 2.048MHz input signal. This acts as reference for the RX and TX frequencies.

The TR412 also contains a 36.864MHz VCXO, which is phase locked to the 8kHz input signal. This acts as clock reference for the controller, the DSP and for the ADC and DAC and thereby the TETRA symbol-generation.

The TX and RX TETRA framing is normally time synchronized to the 1-second hardware input signal together with the information provided in the HDLC message. This ensures that all TETRA counters are running synchronized on the whole BS. If GPS synchronization is present on the BSC, it will also run synchronized with surrounding Base Stations.

#### 4.4.5 DSP

The TR412 is provided with a single high performance DSP handling modulation and demodulation task directly in software. This gives a high degree of freedom to adapt to any changes necessary. When running in TETRA mode the DSP also handles the LMAC and UMAC protocol parts.

The DSP is connected directly via its serial interface to the PCM highway on the back-plane. Four timeslots are reserved for each TR position. All circuit-mode communication is going this way to the PCM switch in the BSC.

The MC is connected to the DSP through its host port and controls its functionality, including software installation and booting. All packed-type communication also passes the host port of the DSP and goes to the BSC via the MC and the HDLC bus.



#### 4.4.6 Micro Controller

The MC is handling the over-all administration of the TR412.

The MC is provided with 1024kByte segmented FLASH memory, containing all the code for the MC as well as for the DSP. One segment contains the boot program, which is used during start-up and software download from the BSC. A 50-pin connector inside the TR412 allows the insertion of an external boot card, which is needed to update the internal boot section. Two segments of the FLASH memory are used to save the factory and system configuration of the TR412.

One of the MC's internal HDLC controllers is used to communicate with the BSC via the HDLC bus and carries all message type communication with the BSC, including TETRA messages, packed-type voice and date, O&M and house-keeping.

Its UART is connected to the UART bus giving an alternative way of O&M communication.

The MC is provided with a watchdog, which will make a restart of the TR at improper operation of the software.





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# 4.5 **RX DIVERSITY FOR BS41**X

Damm Cellular Systems A/S, Denmark

The BS41x TETRA Base Stations are provided with a dual RX diversity scheme allowing the connection of two RX antennas simultaneously to improve the RX sensitivity.

The Base Station can run with only one antenna connected. Connecting a second antenna can however give a considerably improvement of the total BS sensitivity, especially under fading conditions. It is therefore highly recommended to make use of the dual diversity receiver feature.

The BS41x runs with a typical TX output power of about 10 W Tetra at the rack connector. Compared with the typical output power of 1W of a handheld mobile station, a difference of about 10dB in the link budget exists between down-link and up-link, if the same RX sensitivity is present.

Considerably effort has been made in the BS41x to improve RX sensitivity to compensate for the low output power of the handheld subscriber units.

The use of an RX Tower Mounted Amplifier removes the influence of the RX feeders, effectively improving the link balance with the loss of the TX feeder, which could be 2 dB for a typical system.

The use of a dual RX antenna diversity system (space diversity) can improve the sensitivity of BS receiver by up to 7 dB and thereby almost compensate for the remaining difference in the link budget.

This application note describes the implemented diversity scheme of the BS41x and gives typical measured sensitivities and diversity improvements under various conditions.

#### 4.5.1 Diversity implementation

The dual diversity system is implemented with two completely independent receive sections from the RX antenna via the TMA, feeder and RX multi-coupler into the carrier unit. In the carrier unit two independent RX sections exists with first and second IF and two Analog-to-Digital converters connected directly to the DSP.

The DSP thereby receives two completely independent RX signals. First it tries to recover the timing synchronization independently of the two signals and to make a signal quality evaluation.

If the two signals are not very different in quality, they will be added and the combined signal will be used to improve the sensitivity.

If the two signals are very different in quality the best signal will be selected and the other signal will not be used. This is done when the addition of the bad signal to the good one reduces the sensitivity.



The improvement of sensitivity is considerably under fading conditions. If the two received signals are close to being uncorrelated, the probability, that a low input signal level is present on both inputs simultaneously becomes low, effectively removing the fading.

The sensitivity will however also be improved under static conditions, when the two signals are fully correlated. Here close to a 3dB improvement in sensitivity is achieved. This is the same result as if the two antennas were combined directly, however without the problem in obtaining the correct phase of the combination.

The gain of combining under static conditions can also be seen from the result of the combining process. If two equal signals are added, the two input signals are added, effectively giving the double input voltage equal to an increase in input signal of 6dB. The noise is also added. However the two noise signals are fully uncorrelated, and adding the power of the two signals only gives an increase in noise of 3dB. The difference between the 6dB and the 3dB gives the resulting improvement of sensitivity under static conditions of 3dB.

The same improvement of 3 dB is achieved if two signals with fully correlated fading are present. When the two received signals become uncorrelated, the sensitivity improvement will increase.

In the following sections graphs are shown with typical measured RX sensitivity improvements under various conditions.

4.5.2 Diversity gain versus correlation factor

This curve shows the diversity gain (RX sensitivity improvement) for an SCH/F channel (signaling channel) with TU50 fading profile and an MER (Message Error Rate) of 4.7%.

For two fully correlated signals the gain is almost 3dB as described. When the correlation factor approaches zero, the diversity gain is about 7.5 dB.





# 4.5.3 BER versus input signal TCH7.2

These curves show the measured BER (Bit Error Rate) for a standard TCH7.2 traffic channel with the TU50 fading profile. The correlation factor between the two signals is 0.2.



# 4.5.4 MER versus input signal SCH/F

These curves show the measured MER (Message Error Rate) for a standard SCH/F (Signaling Channel Full) with the TU50 fading profile. The correlation factor between the two signals is 0.2.





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# 4.6 **POWER SUPPLY FOR BS41**X

## 4.6.1 Introduction

The BS41x Base Stations are provided with a flexible Power Supply scheme allowing it to run in a variety of different configurations. It can run from either mains AC directly, run from a DC battery source or a combination hereof with battery charging.

Doc No

The different BS versions have space for from 2 to 4 PS411 Power Supply units running in parallel with full power share on all sections. Redundant n+1 operation is provided as all Base Stations can run with full specification with one PS411 out of operation.

All the variants can be connected with an external –48V lead-acid battery and has all the needed circuitry to charge the battery

The PS411 Power Supply contains 4 major parts:

- AC Rectifier providing –48V DC
- DC/DC converter providing +26VDC (for the TX PA)
- DC/DC converter providing +14V DC (for all other BS parts)
- Microprocessor (for charging control, monitoring and alarm generation)

The following number of PS411 is needed depending on the number of carriers installed in the Base Station:

Carriers	No redundancy	N+1 redundancy
1 carrier	1 x PS411	2 x PS411
2 carriers	1 x PS411	2 x PS411
3 carriers	2 x PS411	3 x PS411
4 carriers	2 x PS411	3 x PS411
5 carriers	2 x PS411	3 x PS411
6 carriers	3 x PS411	4 x PS411
7 carriers	3 x PS411	4 x PS411
8 carriers	3 x PS411	4 x PS411

#### 4.6.2 Rectifier

The Rectifier section converts the mains AC input to –48VDC, which can charge the battery and feed the two DC/DC converters. The connection of the battery is optional.

The Rectifier accepts a wide voltage input range, supporting the 3 different standards used worldwide, namely 100V, 115V and 230V. It also accepts both 47Hz and 63Hz. No jumper or setting changes are needed to switch between the variants. However a change of the size of the fuse mounted from the front of the PS411 is needed when changing from 230V to 100/115V. The values are marked on the front plate.

The –48V DC output is fed to a common –48V power rail on the back plane of the cassette. A power sharing circuit ensures close to equal load on all inserted PS411.



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The actual produced output voltage depends of the configuration. When battery charging is active, the delivered output voltage will vary around 54V, controlled of the micro-controller. The accurate value is determined of the charging voltage setting, consisting of a fixed voltage part and an associated temperature compensation setting.

When charging is not selected or the external temperature sensor is not working, the rectifier will deliver 48.0V fixed.

Two different connections are provided on the back plane:

- -48V Battery connection
- -48V DC external load

The –48V battery connection is provided with a current sensor to measure the actual battery charge/discharge current.

The –48V DC external load connection allows the Base Station to drive external units, e.g. Ethernet switches, E1 modems etc.

#### 4.6.3 +14V and +26V DC/DC converters

The PS411 Power Supply contains two independent DC/DC converters providing +14V and +26V respectively from the –48V DC input.

The outputs are fed to two power rails on the back plane. Independent power-share circuits on each converter ensures about equal load on all inserted PS411.

The input to the two converters comes from the external –48V rail. An internal feed is also provided allowing the converters to run even if the external –48V rail is short-circuiting to ground.

The DC/DC converters are able to run on –48V as provided of the rectifier or an external battery.

The input of the DC/DC converters are provided with an under-voltage detector to turn off the load on the battery when nearly discharged to prevent deeply discharge of the battery, which could affect its lifetime. The turn-on voltage is about 45V DC and the turn-off voltage about 40V DC. The 5V hysteresis is provided to prevent oscillations between on and off.



The PS411 is provided with a micro-controller to allow close monitoring of the actual operating condition of the Power Supply. In addition the micro-controller also controls the battery charging voltage.

The PS411 is connected to HDLC-bus in the Base States as well as the serial UART interface. O&M communication is possible on both interfaces.

The PS411 is provided with internal resident settings to hold the charging configurations etc. When used in a BS41x these settings will normally be overwritten of the common configuration received from the active BSC at power-up. The yellow power led on front of the PS411 will flash until the configuration from the BSC is received.



# Part-5: Hardware Units



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# **5.1 HARDWARE UNIT REFERENCES**

Description	Doc. No.
Indoor	
BS 414 Base Station 4-Carrier	
BS 414 Base Station & Carrier	D100200-REF
BS 411 Base Station 8-Carrier High Power	
BSC/12 Base Station Controller	
	D104211-REF
	D104011-REF
	D104011-REF
	D104307-REF
	D104300-REF
CAS417 PS Cassette	D104352-REF
CON411 Connection Box	D104803-REF
External Battery kit for BS41x	D104260-REF
PS411 Power Supply with rectifier	D104251-REF
RMD411 Dual 8-way div.	D104431-REF
RMD414 Dual 4-way div.	D104441-REF
RTC411 RFTL 8-way combiner	D104451-REF
RTC414 RFTL 4-way combiner	D104461-REF
TC411 4-way TX combiner	D104601-REF
TF411 TX filter 25dB	D104701-REF
TH414 4-way hybrid combiner	D104661-REF
TMD412 Tower mounted duplexer	D104531-REF
Al411 Ant. Interface	D104401-REF
Outdoor:	
BS421 Base Station Outdoor	D105001-REF
SB421 Service Box, 1,4GHz	D105101-REF
CS421 2-way Combiner/Splitter	D105911-REF
External log units:	
External log workstation	D105638-REF
External log server	D105639-REF



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#### 5.2 **RECOMMENDED HARDWARE**

The following hardware represents the items used at DAMM These items are not mandatory, but the list indicates items which are tested, and thus can be recommended for use

Doc No

All listed items may be purchased from DAMM

If this recommendation is not used, it is mandatory to procure hardware with similar of better characteristic to ensure a problem free operation of the system

DAMM item	Description	Page No.
No.		
880014	Sealed coaxial cable got BS to BS and BS to Antenna	5-4
105091	Ethernet Cable (Reel of 150m)	5-6
105092	Ethernet Cable (Reel of 500m)	5-6
105093	Power cable BS/BSC421 (Reel of 150m)	5-10
105094	Power cable BS/BSC421 (Reel of 500m)	5-10
798001	Internal Battery SB421 1 piece (4 total in SB421)	5-11
823001	GPS antenna	5-13



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## 5.2.1 Sealed Coaxial cable 880014

tremeflex**							Ø	WIRELESS the intelligence lineals
SFX 500 (1/	2") Super Fle	xible	Cable Spe	ecificatio	ns			row mengeroe inows:
			_					
		_		-				
			property and an orally and the	ing an and other.				
					Nominal Att	envation an	d Average	Power
Cable Type					Frequency Mhz	Atten dB/100 ft	uation dB/100m	Average Power kW
Standard PE jac	:ket		SFX 500 PE		100	0.955	3.13	2.89
Fire Retardant,	Riser Rated, CATVR		SFX 500 R		108	1.01	3.31	2.78
Fire Retardant,	Premise Rated, Non-Ha	logen	SFX 500 NHR		150	1.20	3.94	2.34
					174	1.31	4.30	2.16
Cable Charac	teristics				200	1.42	4.66	2.01
Electrical					300	1./2	0.04	1.02
Impedance, Ohr	ns	50 ± 1			400	2.00	00.0	1.39
Cutoff Frequency	, GH₂	12			500	2.13	7,41	1.23
Velocity %	1147	87			512	2.29	7.51	1.21
Peak Power Ratin	g, kW	15.0			600	2.47	8.10	1.11
DC Resistance, C	Ohms/1000 # (1000m)	0.02	(2.60)		700	2.67	8.76	1.02
Outer		0.85	(2.09)		800	2.83	9.28	0.949
DC Breakdown.	Volts	2500	(=./3)		824	2.89	9.48	0.932
Jacket Spark, Vol	Its RMS	5000			894	3.04	9.97	0.890
Capacitance, pF	d/ft(m)	24.2	(78.9)		960	3.12	10.2	0.855
Inductance, µH/4	t(m)	0.058	(0.19)		1000	3.20	10.5	0.836
VCWD Considerat					1800	4.20	14.43	0.010
vowk specifical	ION				1900	4.51	14.8	0.580
30-2500 MHz		1.10:1	(26.4)		2000	4.70	15.4	0.552
Distance to Fau	h (DTF)				2200	4.86	15.90	0.512
30-2500 MHz		1.006	(50.0)		2300	5.04	16.5	0.508
Mechanical					2400	5.16	16.9	0.495
Jacket	PE or r	iser rated	CMR/CATVR		2500	5.28	17.3	0.483
Outer Conductor	r		Aluminum		2600	5.42	17.8	0.471
Inner Conductor		Сор	per-Clad Al.		3000	6.0/	19.9	0.436
Inner Conductor	Dia., in. (mm)	.140	(3.56)		4000	7.00	23.0	0.300
Dia. Over Outer	Conductor, in. (mm)	.396	(10.1)		6000	0.00	20.2	0.319
Dia. Over Outer	Jacket, in. (mm)	.450	(11.4)		7000	9.91	32.5	0.258
Minimum Bend R	ladius, in. (mm)	1.25	(31.75)	-	8000	10.7	35.1	0.236
Number of Bend	s, min	20		_	9000	11.5	37.7	0.220
Cable Weisht II	r. ff-lbs. (Nm)	0.07	(2./)	-	10000	12.3	40.4	0.202
Tensile Strength	s/π (kg/m) Ibs:/N	250	(113)	-	11000	13.0	42.7	0.190
Flat Plate Crush	Strenath, Ibs./in. (ka/m	m) 95	(1.71)	-	12000	13.7	44.9	0.179
Standard Condition • For Attenuation, pressure, dry air. • For Average Power temperature 40° (1) • Specifications sub	15: /SWR 1.0 ambient tempen tr, VSWR 1.0, inner temper 04*F), atmospheric pressu iget to change without not	ature 20° ( rature 100 re, dry air, ice.	(68°F), atmospheric )* (212°F), ambient ; no solar loading.	-				


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Sales: 1.888.Cell Reach (235.5732) • Fax: 828.466.8617 • Tech Hotline: 800.541.1220 • wireless@commscope.com • www.commscope.com



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∬exans

# SF/UTP Category 6 LSZH + PE 500m reel

Contact

Sales Telecom and data cables SE-514 81 Grimsås Sweden Phone: +46 325 80 000 telecomcable-pc.se@nexans.com



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# exans

# SF/UTP Category 6 LSZH + PE 500m reel

Nexans ref.: 39020671

Characteristics	
Construction characteristics	
Type of cable	S-FTP
Outer sheath	PE
Colour	Black
Inner sheath	Halogen free flame retardant
Dimensional characteristics	
Conductor cross-section (AWG)	24
Diameter over insulation	1.13 mm
Nominal outer diameter (mm)	10.1 mm
Approximate weight (kg/km)	80 kg/km
Electrical characteristics	
Transfer impedance	20
Mutual capacitance (nF/km)	56 nF/km
Max. DC-resistance of the conductor at 20° C	70 Ohm/km
Characteristic impedance	100 Ohm
Transmission characteristics	
Attenuation, max. 250 MHz	32.8 dB/100m
Near End Crosstalk @ 250 MHz	38.3 dB
Attenuation Crosstalk Ratio, 250MHz	5.5 dB/100m
Powersum Near End Crosstalk, 250MHz	36.3 dB
Powersum Equal Level Far End Crosstalk, 250MHz	19 dB
Return loss, 250MHz	17.3 dB
Skew	30 ns/100m
Velocity of propagation	68.0 %
Coupling attenuation at 30 MHz	80 dB
Propagation delay, max. 100 MHz	536 ns/100m
Usage characteristics	
Packaging	Reel
Length (m)	500 m
Category	Cat. 6
Flame retardant	No
Component function	Cable
Operating temperature, range	-20 40 °C
Ambient installation temperature, range (°C)	-10 50 °C
Minimum static operating bending radius	41.0 mm
Laying operation bending radius	81.0 mm

#### Electrical Performance

Frequency	Attenuation	NEXT pr/pr	ACR	PS NEXT	EL-FEXT pr/pr	PS EL-FEXT	RL
MHz	d <b>B</b> /100 m	dB	dB/100 m	dB	d <b>B</b> /100 m	d <b>B</b> /100 m	dB
1	2.0	74.3	72.3	72.3	70.0	67.0	20
4	3.8	65.3	61.5	63.3	58.0	55.0	23
10	6.0	59.3	53.3	57.3	50.0	47.0	25

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16	7.6	56.2	48.6	54.3	45.9	42.9	25
20	8.5	54.8	46.3	52.8	44.0	41.0	25
31.25	10.7	51.9	41.2	49.9	40.5	37.5	23.6
62.5	15.4	47.4	32.0	45.4	34.1	31.1	21.5
100	19.8	44.3	24.5	42.3	30.0	27.0	20.1
155	25.2	41.4	16.2	39.5	26.2	23.2	18.8
200	29.0	39.8	10.8	37.8	24.0	21.0	18.0
250	32.8	38.3	5.5	36.3	22.0	19.0	17.3
300	36.4	37.1	1.5	35.2	20.5	17.5	16.8
350	39.8	36.1	-	34.2	19.1	16.1	14.1

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# 5.2.3 Power cable 105093 / 105094

NHH-J	24					
Halogen f	ree, flame	retardant, n	on corrosive	, low smoke in	nstallation of	able
100 V						
Constructi	on accord	ding to DS 23	93, HD 21.5	S3		
IEC 60332-1 IEC 60754 IEC 61034		EN 50265-2-1 EN 50267 EN 50268		Flame retardant Halogen free, no Low smoke den	on corrosive sity	
Application						
For fixed insta Burial in soil is	allation on su s allowed, as	urface indoors an s long as the rele	id outdoors, or ir want national rul	laid in conduits, c es of installation a	anals and hollo re followed.	ow constructio
Max. operatin	g temperatu	re /0 "C	100000000000000000000000000000000000000			
Max. operatin Max. tempera Min. handling Min. bending Max. pulling k Construction	g temperatu ture in short temperature radius 10 x o pad when pu	re 70 °C circuit 160 °C fo -20 °C cable diameter illing from the co	r max. 5 s nductors A x 50	N/mm² (A≃total ar	rea of the cond	uctors)
Max. operatin Max. tempera Min. handling Min. bending Max. pulling k Construction Conductor: Insulation: Identification: Outer sheath:	g temperatu ture in short temperature radius 10 x ( bad when pu	<ul> <li>circuit 160 °C for circuit 160 °C for cable diameter</li> <li>cable diameter</li> <li>from the contract of the contract o</li></ul>	r max. 5 s nductors A x 50 ircular stranded blyolefin compou rellow, blue, blac blyolefin compou	N/mm² (A=total ar copper (IEC 6022 nd k nd,	rea of the cond	uctors)
Max. operatin Max. tempera Min. handling Min. bending Max. pulling k Construction Conductor: Insulation: Identification: Outer sheath: REKA code	g temperatu ture in short temperature radius 10 x ( bad when pu Size	re 70 °C circuit 160 °C fo 2 -20 °C cable diameter illing from the co 1,52,5 mm² c Halogen free po 3 core ; green-y Halogen free po Colour black	ir max. 5 s nductors A x 50 bircular stranded byolefin compou vellow, blue, blac blyolefin compou linsulation thickness average mm	N/mm² (A=total ar copper (IEC 6022 nd k nd, Oversheath thickness nominal mm	ea of the cond 8 cl 2 RM) Outer diameter maximum mm	Weight approximate
Max. operatin Max. tempera Min. handling Min. bending Max. pulling k Construction Conductor: Insulation: Identification: Outer sheath: REKA code	g temperatu ture in short temperature radius 10 x o bad when pu Size 3x1,5	circuit 160 °C fo circuit 160 °C fo cable diameter able diameter illing from the co 1,52,5 mm² of Halogen free po Colour black Conductor resistance DC +20 °C ohm / km	r max. 5 s nductors A x 50 bircular stranded blyolefin compou ellow, blue, blac blyolefin compou linsulation thickness average mm 0,7	N/mm² (A=total ar copper (IEC 6022 nd k nd, Oversheath thickness nominal mm	Outer diameter maximum 8,5	Weight approximate kg / km
Max. operatin Max. tempera Min. handling Min. bending Max. pulling k Construction Conductor: Insulation: Identification: Outer sheath: REKA code 1702355	g temperatu ture in short temperature radius 10 x o bad when pu Size 3x1,5	re 70 °C circuit 160 °C fo e -20 °C cable diameter illing from the co 1,52,5 mm² of Halogen free po Colour black Conductor resistance DC +20 °C ohm / km 12,1	r max. 5 s nductors A x 50 bircular stranded blyolefin compou ellow, blue, blac blyolefin compou linsulation thickness average mm 0,7	N/mm² (A=total ar copper (IEC 6022 nd k nd, Oversheath thickness nominal mm 0,9	Outer diameter maximum 8,5	Weight approximate kg / km 100
Max. operatin Max. tempera Min. handling Min. bending Max. pulling k Construction Conductor: Insulation: Identification: Outer sheath: REKA code 1702355	g temperatu ture in short temperature radius 10 x o bad when pu Size 3x1,5	circuit 160 °C fo circuit 160 °C fo cable diameter able diameter for the co 1,52,5 mm² of Halogen free po 3 core ; green-y Halogen free po Colour black Conductor resistance DC +20 °C ohm / km 12,1	r max. 5 s nductors A x 50 bircular stranded byolefin compou rellow, blue, blac byolefin compou linsulation thickness average mm 0,7	N/mm² (A=total ar copper (IEC 6022 nd k nd, Oversheath thickness nominal mm 0,9	Outer Outer diameter maximum mm 8,5	uctors) Weight approximate kg / km 100

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# 5.2.4 SB421 internal battery 7980001



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TETRAFLEX<sup>®</sup> V7.5 MANUAL - Recommended hardware





TETRAFLEX<sup>®</sup> V7.5 MANUAL - Recommended hardware

Rev.

1.00

# 5.2.5 GPS antenna 8230001

Timing 3000 AntennaPhysical ChaDimensions:Weight: Weight: Weight: Connector:Weight: Weight: Weight: Connector:Operating Temperature Storage Temperature Dimensions: Weight: Weig	racteristics: eter Value 102 diameter x 82 height (mm) 312 grams Center mount (M28 nut) N-Connector (jack style) Il Specifications: eter Value 40° C to +85° C Range: 40° C to +100° C Range: 95% noncondensing : JIS D0202 (Sunshine Carbon Arc System) st: Spray 5% NaCl solvent at 35°C st: 1 meter (with connector sealed) e Test +/- 12 kV ormance measurements are typical and 25°C unless indicated otherwise. Drawing:
Physical Cha Paran Dimensions: Weight: Mount Connector:General Description:The Timing 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna.• Dual Pole Filter 40dB minimum at +/- 50MHz • Dual Pole Filter 40dB minimum at +/- 50MHz• Dual Pole Filter 40dB minimum at +/- 50MHz • Duals with optional Right Angle Bracket or Pipe Adaptor • 25 dB Gain Typical• General Characteristics:• Dual Pole Filter 40dB minimum at +/- 50MHz • Duals with optional Right Angle Bracket or Pipe Adaptor • 25 dB Gain Typical• Dual Pole Filter 40dB minimum at +/- 50MHz • Duals with optional Right Angle Bracket or Pipe Adaptor • 25 dB Gain Typical• Dual Role Filter 40dB minimum at +/- 50MHz • Duals with optional Right Angle Bracket or Pipe Adaptor • 25 dB Gain Typical• Dual Role Filter 40dB minimum at +/- 50MHz • Dimensional Right Angle Bracket or Pipe Adaptor • 25 dB Gain Typical• Dimensional Right Hand Circular Azimuth Coverage: Gain Characteristics • 10 dBic minimum at zenith of Antenna Element: • 10 dBic minimum at 0° elevation• Diarization: Cain Coverage: Gain Characteristics • 10 dBic minimum at 20° theorem • 10 dBic minimum at 20° theorem • 10 dBic minimum at 20° theorem • 10 dBic minimum at 0° elevation	racteristics: eter Value 102 diameter x 82 height (mm) 312 grams Center mount (M28 nut) N-Connector (jack style) al Specifications: eter Value 40° C to +85° C Range: 40° C to +100° C Range: 95% noncondensing UIS D0202 (Sunshine Carbon Arc System) st: Spray 5% NaCl solvent at 35°C st: 1 meter (with connector sealed) st: Spray 5% NaCl solvent at 35°C st: 1 meter (with connector sealed) st erst: +/- 12 kV ormance measurements are typical and 25°C unless indicated otherwise. Drawing:
Parameter       Value         Operating Tremperature       Start Synap         Seneral Description:       Transient Voltag         The Timing 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna.       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Duesigned for Tixed mount Precision       Timing and Network Syncronization         • 25 dB Gain Typical       at         Bandwidth:       25 MHz (typical) +/- 3dB points         Polarization:       #10 dBic minimum at zen	eter Value       eter     Value       102 diameter x 82 height (mm)       312 grams       Center mount (M28 nut)       N-Connector (jack style)       Il Specifications:       eter     Value       40° C to +85° C       Range:       95% noncondensing       IIS D0202 (Sunshine Carbon Arc System)       st:     Spray 5% NaCl solvent at 35°C       st:     1 meter (with connector sealed)       eTest:     +/- 12 kV       Dormance measurements are typical and 25°C unless indicated otherwise.
Designed for fixed mount Precision Timing and Network Syncronization 25 dB Gain TypicalDimensional Connector:Seneral Characteristics:Parameter Note: All per referenced to Designed for fixed mount Precision Timing and Network Syncronization 25 dB Gain TypicalDimensional Time Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Sionage Temperature Transient Votag Note: All per referenced to Dimensional Timing and Network Syncronization 25 dB Gain TypicalDimensional Timing and Network Syncronization Sioname To Bignet for fixed mount Precision Timing and Network Syncronization 25 dB Gain TypicalDimensional Timing and Network Syncronization Sioname To Bignet fixed mount Precision Timing and Network Syncronization 25 dB Cain TypicalDimensional Timing and Network Syncronization To Bignet fixed mount Precision Timing and Network Syncronization To Signet fixed mount Precision Timing and Network Syncronization 	312 grams       Center mount (M28 nut)       N-Connector (jack style)       Il Specifications:       eter     Value       40° C to +85° C       Range:       -40° C to +100° C       Range:       95% noncondensing       :     JIS D0202 (Sunshine Carbon Arc System)       st:     Spray 5% NaCl solvent at 35°C       st:     Spray 5% NaCl solvent at 35°C       rest     +/- 12 kV       ormance measurements are typical and 25°C unless indicated otherwise.       Drawing:
With the second seco	Center mount (M28 nut) N-Connector (jack style) al Specifications: eter Value 40° C to +85° C Range: 40° C to +100° C Range: 95% noncondensing US D0202 (Sunshine Carbon Arc System) st: Spray 5% NaCl solvent at 35°C st: 1 meter (with connector sealed) ETest +/- 12 kV prmance measurements are typical and 25°C unless indicated otherwise. Drawing:
General Description:       Environment         Transient Votag       Sait Spray Tr         Immersion Tr       Immersion Tr         Transient Votag       Note: All performersion Vote: All performersion Transient Votag         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Sugged N Style Coaxial Connector       Dimensional         • Mounts with optional Right Angle Bracket or Pipe Adaptor       Dimensional         • Designed for fixed mount Precision Timing and Network Syncronization       at         • 25 dB Gain Typical       at         General Characteristics:       at         VSWR:       1.5 (typical)         • Diarization:       Right Hand Circular         Azimuth Coverage:       380°         Elevation Coverage:       380°         Elevation Coverage:       20 dBic minimum at 20° elevation         • Creating Inform       Ordering Inform	N-Connector (jack style)       Il Specifications:       eter     Value       40° C to +85° C       Range:       40° C to +100° C       Range:       95% noncondensing       Il S D0202 (Sunshine Carbon Arc System)       st:     Spray 5% NaCl solvent at 35°C       st:     1 meter (with connector sealed)       arest     +/-12 kV       prmance measurements are typical and 25°C unless indicated otherwise.       Drawing:
Environment         Param         Operating         Temperature         Storage         Temperature         Humidity:         UV Radiation         Salt Spray Tri         Immersion Tri         The Timing 3000 is a 100% form, fit, function replacement         for the original Motorola Timing2000 GPS Antenna.         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Rugged N Style Coaxial Connector         • Mounts with optional Right Angle Bracket         or Pipe Adaptor         • Designed for fixed mount Precision         Timing and Network Syncronization         • 25 dB Gain Typical         General Characteristics:         Parameter         VSWR:       1.5 (typical) +/- 3dB points         Polarization:       Right Hand Circular         Azimuth Coverage:       380°         Elevation Coverage:       0° to 80°         Gain Characteristics       Ordering Info         Gain Characteristics       -10 dBic minimum at 2° elevation	eter Value eter Value 40° C to +85° C Range: 40° C to +100° C Range: 95% noncondensing US D0202 (Sunshine Carbon Arc System) st: Spray 5% NaCl solvent at 35°C st: 1 meter (with connector sealed) ETest +/- 12 kV prmance measurements are typical and 25°C unless indicated otherwise. Drawing:
Environment         Param         General Description:         The Timing 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna.         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Dual Pole Filter 40dB minimum at -/- 50MHz         • Dual Pole Filter 40dB minimum at +/- 50MHz         • Designed for fixed mount Precision         • Timing and Network Syncronization         • 25 dB Gain Typical         • So Ohm         • So So Ohm         • So So Ohm	eter Value eter Value 40° C to +85° C Range: 40° C to +100° C Range: 95% noncondensing US D0202 (Sunshine Carbon Arc System) st: Spray 5% NaCl solvent at 35°C st: 1 meter (with connector sealed) Etest +/- 12 kV prmance measurements are typical and 25°C unless indicated otherwise. Drawing:
Parameter       Value         Operating Temperature       Storage         Transient Votagion       UV Radiation         Salt Spray Temperature       Humidity:         UV Radiation       Salt Spray Temperature         Humidity:       UV Radiation         Salt Spray Temperature       Salt Spray Temperature         Humidity:       UV Radiation         Salt Spray Temperature       Salt Spray Temperature         Humidity:       UV Radiation         Salt Spray Temperature       Salt Spray Temperature         Humidity:       UV Radiation         Salt Spray Temperature       Salt Spray Temperature         Note: All perint       Transient Votagion         * Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         * Dual Pole Filter 40dB mount Precision       Dimensional         Timing and Network Syncronization       -25 dB Gain Typical         General Characteristics:       Imput Impedances: 50 Ohm         VSWR:       1.5 (typical) +/- 3dB points         Polarization:       Right Hand Circular         Azimuth Coverage:       380°         Elevation Coverage:       0° to 80°         Gain Characteristics       -10 dBic minimum at 2° elevation         Ordering Info       Ordering In	eter     Value       40° C to +85° C       Range:       40° C to +100° C       Range:       95% noncondensing       IS D0202 (Sunshine Carbon Arc System)       st:     Spray 5% NaCl solvent at 35°C       ist:     1 meter (with connector sealed)       Etest:     +/- 12 kV       parmance measurements are typical and 25°C unless indicated otherwise.       Drawing:
General Description:       Sait Spray Temperature         Temperature       Humidity:         UV Radiation       Sait Spray Temperature         Humidity:       UV Radiation         Sait Spray Temperature       Humidity:         UV Radiation       Sait Spray Temperature         Source       Sait Spray Temperature         Humidity:       UV Radiation         Sait Spray Temperature       Sait Spray Temperature         Humidity:       UV Radiation         Sait Spray Temperature       Sait Spray Temperature         Humidity:       UV Radiation         Sait Spray Temperature       Sait Spray Temperature         Humidity:       UV Radiation         Sait Spray Temperature       Immersion Timescon         * Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         * Dual Pole Filter 40dB mount Precision       Dimensional         Timing and Network Synconization       25 dB Gain Typical         General Characteristics:       Imput Impedances: 50 Ohm         YSWR:       1.5 (typical) +/- 3dB points         Polarization:       Right Hand Circular         Azimuth Coverage:       380°         Elevation Coverage:       0° to 80°         Gain Characteristics       +10 dBic minimum at 2°	Range: 40° C to +100° C Range: 95% noncondensing USUNShine Carbon Arc System) st: Spray 5% NaCl solvent at 35°C st: 1 meter (with connector sealed) ETest: +/- 12 kV prmance measurements are typical and 25°C unless indicated otherwise. Drawing:
General Description:       Salt Spray Tellumidity:         UV Radiation       Salt Spray Tellumidity:         Note: All per       Transient Votage         Note: All per       Tellumidity:         * Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         * Obsigned for fixed mount Precision       Timing and Network Syncronization       Dimensional         * 25 dB Gain Typical       So Ohm       So Tellumidity:       So Tellumidity:         YSWR:       1.5 (typical) +/- 3dB points       So Tellumidity:       So Tellumidity:         YSWR:       20	40° C to +100° C Range:  95% noncondensing  UIS D0202 (Sunshine Carbon Arc System) st: Spray 5% NaCl solvent at 35°C st: 1 meter (with connector sealed) arest +/- 12 kV prmance measurements are typical and 25°C unless indicated otherwise. Drawing:
General Description:       Temperature         The Timing 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna.       UV Radiation         • Dual Pole Filter 40dB minimum at +/- 50MHz       Note: All per referenced to         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Dusigned for fixed mount Precision       Timing and Network Syncronization       25 dB Gain Typical         General Characteristics:       Temperature       To the state of	Range:       95% noncondensing         JIS D0202 (Sunshine Carbon Arc System)         st:       Spray 5% NaCl solvent at 35°C         st:       1 meter (with connector sealed)         rTest       +/- 12 kV         prmance measurements are typical and 25°C unless indicated otherwise.         Drawing:
General Description:       Humidity:         UV Radiation       Salt Spray Television Television Television Television Television Television Television Television         The Timing 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna.       Note: All performance television Television         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Rugged N Style Coaxial Connector       Dimensional         • Mounts with optional Right Angle Bracket       or Pipe Adaptor         • Designed for fixed mount Precision       Timing and Network Syncronization         • 25 dB Gain Typical       attracteristics:         Parameter       Value         Operating Frequency:       1575.42 MHz, +/-2 MHz         Input Impedances:       50 Ohm         VSWR:       1.5 (typical) +/- 3dB points         Polarization:       Right Hand Circular         Azimuth Coverage:       380°         Elevation Coverage:       0° to 80°         Gain Characteristics       +2.0 dBic minimum at zenith of Antenna Element:       -10 dBic minimum at 0° elevation	95% noncondensing           JIS D0202 (Sunshine Carbon Arc System)           st:         Spray 5% NaCl solvent at 35°C           st:         1 meter (with connector sealed)           st:         1 meter (with connector sealed)           streat         +/- 12 kV           prmance measurements are typical and 25°C unless indicated otherwise.           Drawing:
General Description:       UV Radiation         The Timing 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna.       Note: All performance of the provided and	JIS D0202 (Sunshine Carbon Arc System) st: Spray 5% NaCl solvent at 35°C st: 1 meter (with connector sealed) PTest +/- 12 kV prmance measurements are typical and 25°C unless indicated otherwise.
General Description:       UV Radiation         The Timing 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna.       Note: All performance of the provided and	IIS D0202 (Sunshine Carbon Arc System) st: Spray 5% NaCl solvent at 35°C st: 1 meter (with connector sealed) rest: +/- 12 kV prmance measurements are typical and 25°C unless indicated otherwise.
General Description:       Salt Spray Trimersion Triming 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna.       Note: All performation trefferenced to the original Motorola Timing2000 GPS Antenna.         • Dual Pole Filter 40dB minimum at +/- 50MHz       Dimensional         • Nuts with optional Right Angle Bracket or Pipe Adaptor       Dimensional         • Designed for fixed mount Precision Timing and Network Syncronization       25 dB Gain Typical         General Characteristics:       Parameter       Value         Operating Frequency:       157.42 MHz, +/-2 MHz         Input Impedances:       50 Ohm         VSWR:       1.5 (typical) +/- 3dB points         Polarization:       Right Hand Circular         Azimuth Coverage:       380°         Elevation Coverage:       0° to 90°         Gain Characteristics       +2.0 dBic minimum at zenith of Antenna Element:       -10 dBic minimum at 0° elevation	Isunsnine Carbon Arc System) st: Spray 5% NaCl solvent at 35°C ist: 1 meter (with connector sealed) a Test: +/- 12 kV prmance measurements are typical and 25°C unless indicated otherwise. Drawing:
General Description:     Sait Spray 1/v       The Timing 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna.     Note: All per referenced to       • Dual Pole Filter 40dB minimum at +/- 50MHz     Dimensional       • Rugged N Style Coaxial Connector     Dimensional       • Mounts with optional Right Angle Bracket or Pipe Adaptor     Dimensional       • Designed for fixed mount Precision Timing and Network Syncronization     Image: Source and the synchronization       • 25 dB Gain Typical     av       General Characteristics:     Value       Parameter     Value       Operating Frequency:     157.542 MHz, +/-2 MHz       Input Impedances:     50 Ohm       VSWR:     1.5 (typical) +/- 3dB points       Polarization:     Right Hand Circular       Azimuth Coverage:     380°       Elevation Coverage:     0° to 80°       Gain Characteristics     +2.0 dBic minimum at 20° elevation	Trest: 1 meter (with connector sealed) a Trest: 1/- 12 kV prmance measurements are typical and 25°C unless indicated otherwise. Drawing:
The Timing 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna. • Dual Pole Filter 40dB minimum at +/- 50MHz • Rugged N Style Coaxial Connector • Mounts with optional Right Angle Bracket or Pipe Adaptor • Designed for fixed mount Precision Timing and Network Syncronization • 25 dB Gain Typical General Characteristics: Parameter Value Operating Frequency: 1575.42 MHz, +/-2 MHz Input Impedances: 50 Ohm VSWR: 1.5 (typical) +/- 3dB points Polarization: Right Hand Circular Azimuth Coverage: 380° Elevation Coverage: 0° to 90° Gain Characteristics +2.0 dBic minimum at zenith of Antenna Element: -10 dBic minimum at 0° elevation	25°C unless indicated otherwise.
The Timing 3000 is a 100% form, fit, function replacement for the original Motorola Timing2000 GPS Antenna. • Dual Pole Filter 40dB minimum at +/- 50MHz • Rugged N Style Coaxial Connector • Mounts with optional Right Angle Bracket or Pipe Adaptor • Designed for fixed mount Precision Timing and Network Syncronization • 25 dB Gain Typical General Characteristics: Parameter Value Operating Frequency: 1575.42 MHz, +/-2 MHz Input Impedances: 50 Ohm VSWR: 1.5 (typical) +/- 3dB points Polarization: Right Hand Circular Azimuth Coverage: 380° Elevation Coverage: 0° to 90° Gain Characteristics +2.0 dBic minimum at zenith of Antenna Element: -10 dBic minimum at 0° elevation	ormance measurements are typical and 25°C unless indicated otherwise.
for the original Motorola Timing2000 GPS Antenna.	25°C unless indicated otherwise.
<ul> <li>Dual Pole Filter 40dB minimum at +/- 50MHz</li> <li>Rugged N Style Coaxial Connector</li> <li>Mounts with optional Right Angle Bracket or Pipe Adaptor</li> <li>Designed for fixed mount Precision Timing and Network Syncronization</li> <li>25 dB Gain Typical</li> <li>General Characteristics:</li> <li>Parameter Value Operating Frequency: 1575.42 MHz, +/-2 MHz Input Impedances: 50 Ohm VSWR: 1.5 (typical) +/- 3dB points Polarization: Right Hand Circular Azimuth Coverage: 380°</li> <li>Elevation Coverage: 0° to 90°</li> <li>Gain Characteristics +2.0 dBic minimum at zenith of Antenna Element: -10 dBic minimum at 0° elevation</li> </ul>	Drawing:
Rugged N Style Coaxial Connector     Mounts with optional Right Angle Bracket     or Pipe Adaptor     Designed for fixed mount Precision     Timing and Network Syncronization     25 dB Gain Typical     General Characteristics:     Parameter     Value     Operating Frequency: 1575.42 MHz, +/-2 MHz     Input Impedances: 50 Ohm     VSWR:     1.5 (typical)     Bandwidth:     25 MHz (typical) +/- 3dB points     Polarization:     Right Hand Circular     Azimuth Coverage:     380°     Elevation Coverage:     0° to 90°     Gain Characteristics     +2.0 dBic minimum at zenith     ordering Info     of Antenna Element:     -10 dBic minimum at 0° elevation	
Mounts with optional Right Angle Bracket or Pipe Adaptor     Designed for fixed mount Precision     Timing and Network Syncronization     25 dB Gain Typical     General Characteristics:     Parameter     Value     Operating Frequency: 1575.42 MHz, +/-2 MHz     Input Impedances: 50 Ohm     VSWR:     1.5 (typical) Bandwidth:     25 MHz (typical) +/- 3dB points Polarization:     Right Hand Circular     Azimuth Coverage:     380° Elevation Coverage:     0° to 90° Gain Characteristics     +2.0 dBic minimum at zenith     Ordering Infec     of Antenna Element:     -10 dBic minimum at 0° elevation	
or Pipe Adaptor   • Designed for fixed mount Precision  Timing and Network Syncronization  • 25 dB Gain Typical  General Characteristics:  Parameter Value Operating Frequency: 1575.42 MHz, +/-2 MHz Input Impedances: 50 Ohm VSWR: 1.5 (typical) Bandwidth: 25 MHz (typical) +/- 3dB points Polarization: Right Hand Circular Azimuth Coverage: 380° Elevation Coverage: 0° to 90° Gain Characteristics +2.0 dBic minimum at 2enith Ordering Info	
Designed for fixed mount Precision     Timing and Network Syncronization     25 dB Gain Typical     General Characteristics:     Parameter     Value     Operating Frequency: 1575.42 MHz, +/-2 MHz     Input Impedances: 50 Ohm     VSWR:     1.5 (typical)     Bandwidth:     25 MHz (typical) +/- 3dB points     Polarization:     Right Hand Circular     Azimuth Coverage:     380°     Elevation Coverage:     0° to 90°     Gain Characteristics     +2.0 dBic minimum at zenith     Ordering Info     f Antenna Element:     -10 dBic minimum at 0° elevation     Part No	
Control Contro Control Control Control Control Control Control Control Control Co	
Second State Pyper and State	
General Characteristics:         Parameter       Value         Operating Frequency:       1575.42 MHz, +/-2 MHz         Input Impedances:       50 Ohm         VSWR:       1.5 (typical)         Bandwidth:       25 MHz (typical) +/- 3dB points         Polarization:       Right Hand Circular         Azimuth Coverage:       380°         Elevation Coverage:       0° to 90°         Gain Characteristics       +2.0 dBic minimum at zenith of Antenna Element:       Ordering Info         Ordering Info       Part No	1
Parameter         Value           Operating Frequency:         1575.42 MHz, +/-2 MHz           Input Impedances:         50 Ohm           VSWR:         1.5 (typical)           Bandwidth:         25 MHz (typical) +/- 3dB points           Polarization:         Right Hand Circular           Azimuth Coverage:         380°           Elevation Coverage:         0° to 90°           Gain Characteristics         +2.0 dBic minimum at zenith of Antenna Element:         -10 dBic minimum at 0° elevation	/ \
Operating Frequency:       1575.42 MHz, +/-2 MHz         Input Impedances:       50 Ohm         VSWR:       1.5 (typical)         Bandwidth:       25 MHz (typical) +/- 3dB points         Polarization:       Right Hand Circular         Azimuth Coverage:       380°         Elevation Coverage:       0° to 90°         Gain Characteristics       +2.0 dBic minimum at zenith         of Antenna Element:       -10 dBic minimum at 0° elevation	$\prec$
Input Impedances: 50 Ohm VSWR: 1.5 (typical) Bandwidth: 25 MHz (typical) +/- 3dB points Polarization: Right Hand Circular Azimuth Coverage: 380° Elevation Coverage: 0° to 90° Gain Characteristics +2.0 dBic minimum at 2enith of Antenna Element: -10 dBic minimum at 0° elevation Part Nu	
VSWR: 1.5 (typical) Bandwidth: 25 MHz (typical) +/- 3dB points Polarization: Right Hand Circular Azimuth Coverage: 360° Elevation Coverage: 0° to 90° Gain Characteristics +2.0 dBic minimum at zenith of Antenna Element: -10 dBic minimum at 0° elevation Part Nu	
Bandwidth: 25 MHz (typical) +/- 3dB points Polarization: Right Hand Circular Azimuth Coverage: 360° Elevation Coverage: 0° to 90° Gain Characteristics +2.0 dBic minimum at zenith of Antenna Element: -10 dBic minimum at 0° elevation Part Nu	
Azimuth Coverage: 380° Elevation Coverage: 0° to 90° Gain Characteristics +2.0 dBic minimum at zenith of Antenna Element: -10 dBic minimum at 0° elevation Part No	ACROES FLATS
Elevation Coverage: 0° to 90° Gain Characteristics +2.0 dBic minimum at zenith Ordering Info of Antenna Element: -10 dBic minimum at 0° elevation Part No	RETAINING NUT 28MM
Gain Characteristics +2.0 dBic minimum at zenith Ordering Info of Antenna Element: -10 dBic minimum at 0° elevation Part Nu	100 m
of Antenna Element: -10 dBic minimum at 0° elevation Part Nu	mation:
	mber Configuration
Filtering: 40dB minimum @ +/-50 MHz 10001724	with N connector
LNA Gain: 25dB (typical)	
Noise Figure: 1.5dB (typical) Accessories:	
Dynamics: Vibration: SAE J1455 Part No	mber Configuration
10001725	Right angle mount bracket
Electrical Characteristics: 10001511-1	Converts M28x1 to 3/4in NPT
Parameter Value	& 1-14 Marine
Power Requirements: 5 7/- 0.25 Vdc (hypical) 10001511-0	with sets row
	WILLI SELSCIEW
For configuration assistance, order placement and t	
	echnical support call:
SUNERGU SUSTEMS, LLC Phone: (858) 50	echnical support call:
I	echnical support call:



#### 5.2.6 MPE declaration



# Maximum Permissible Exposure Calculations

Product:	D/ BS	AMM TE1 3421, BS4	FRA Ba 411, BS	ase Sta S412, E	tions 8S414	Docu	iment No.:	128948/5	d
Introduction	1								
The Europea Recommand (0 Hz to 300 the reference	an limits for m lation of 12. J GHz), Annex e levels of ex	naximum permi luly 1999 on th k II, Table 1, of posure. Meetin	issible expo e limitation this docum ig the refere	osure are de of exposure ent defines ence levels	efined in do e of the ger the basic r ensures the	cument 199 heral public estrictions. e meeting o	95/519/EC, to electrom Annex III, T f the basic	Council Synetic fields Table 2, defin restrictions.	es www
From table 2 to 2000 MHz Base Station	, in the frequ , the maximu is BS421,BS4	ency range fro im power dens 411, BS412 an	m 10 to 400 ity is F/200 d BS414 tra	0 MHz, the W/m², whe ansmits in t	maximum p re (f) is the he UHF bar	ower densi frequency. nd in differe	ty(S) is 2 W The DAMN int frequenc	//m². From 40 I TETRA :y bands.	)O mmko.com
Calculation	of Safety Di	stance at MPE	<u>E limit</u>						
S = <u>PG</u> 4πF	orF	$R = \sqrt{\frac{PG}{4\pi S}}$							
S= Power De P= (Power in G= Power ga R= Distance	<b>S</b> = Power Density P= (Power input to the antenna) G= Power gain of the antenna in the direction of interest relative to an isotropic radiator R= Distance to the centre of radiation of the antenna								
BS42110W1 carriers Ptot= Carrier + 10log(N) +3 dB (ant.gain) = 20WBS41110W8 carriers Ptot= Carrier + 10log(N) +3 dB (ant.gain) = 160WBS411H25W8 carriers Ptot= Carrier + 10log(N) +3 dB (ant.gain) = 400WBS4127,5W2 carriers Ptot= Carrier + 10log(N) +3 dB (ant.gain) = 30WBS41410W4 carriers Ptot= Carrier + 10log(N) +3 dB (ant.gain) = 80WBS414H25W4 carriers Ptot= Carrier + 10log(N) +3 dB (ant.gain) = 200W									
Safety Distance from centre of radiation of the antenna (cm)									
Freq. Band (MHz)	Table 2	Maximum power density S (mW/cm <sup>2</sup> )	BS421 Safety Distance 1 Ch.	BS411 Safety Distance 8 Ch.	BS411H Safety Distance 8 Ch.	BS414 Safety Distance 4 Ch.	BS414H Safety Distance 4 Ch.	BS412 Safety Distance 2 Ch.	
336 - 346	2/10	0,2	89,21	252,31	398,94	178,41	282,10	109,26	1
360 - 370	2/10	0,2	89,21	252,31	398,94	178,41	282,10	109,26	
390 - 400	2/10	0,2	89,21	252,31	398,94	178,41	282,10	109,26	
420 - 430	(t/200)/10	0,2125	86,54	244,78	387,03	173,09	273,67	105,99	4
460 - 470	(1/200)/10	0,2325	02,14	234,02	370,01	105,47	261,64	101,33	-
010 - 000	(1/200)/10	0,45	00,04	172,08	212,00	121,68	192,39	74,51	1

Council Recommandation 1995/519/EC Relevant Standard EN50385:2002

Date: 2011-10-06

Rog lagerad

Roy Uggerud, Certification Manager

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