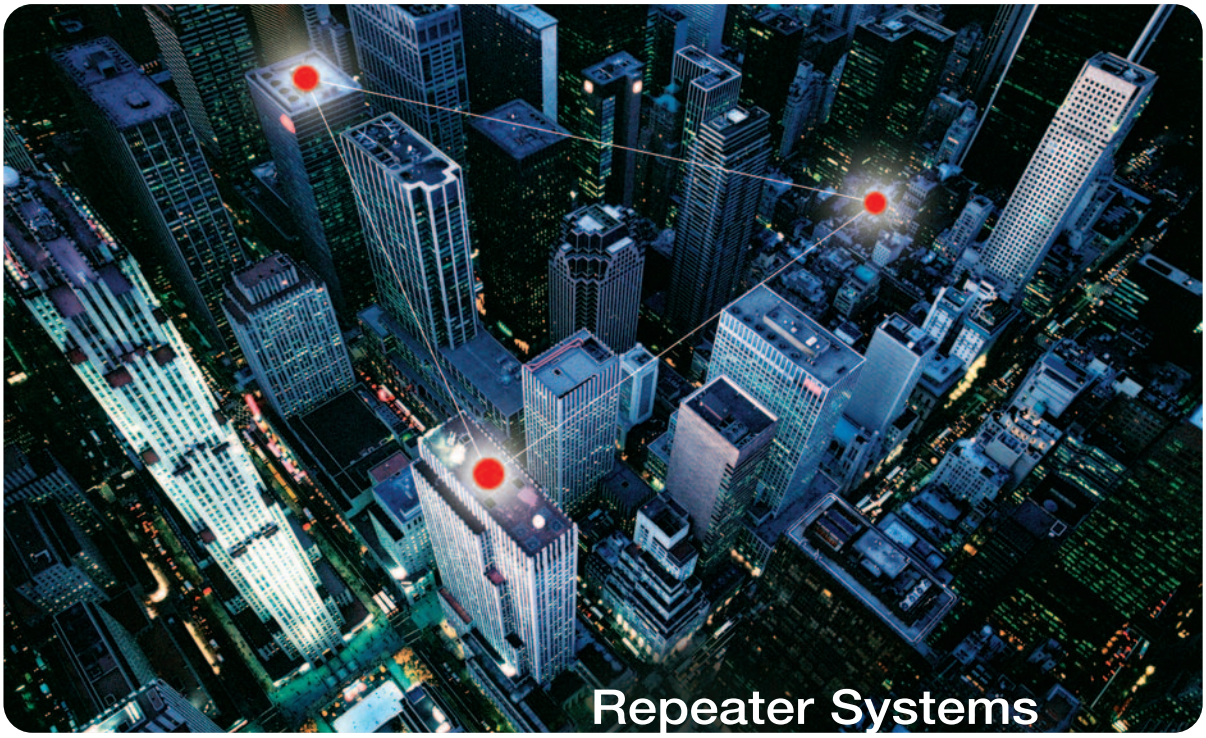


Product Overview

CHANNEL SELECTIVE REPEATERS
BAND SELECTIVE REPEATERS
BAND SELECTIVE COMPACT REPEATERS
FIBER OPTIC REPEATERS
DISTRIBUTED ANTENNA SYSTEMS
REMOTE RADIO HEAD

Powerwave® technologies

Quick Reference Guide

reference

table of contents

LB = Low band
UB = Upper band
HP = High Power
R2R = Repeater to repeater
RCU/RCC = Remote control unit
PSU = Power supply

Default values = shaded areas

Repeater Configuration Options

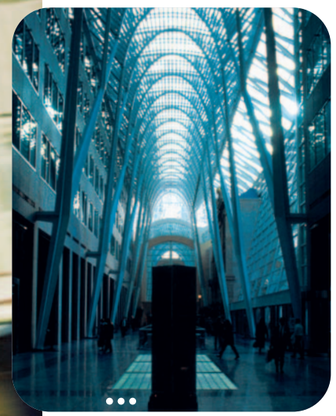
Repeater Base Model	Product Number	Options: No. of Channels 2	4	6	8	Bandwidth MHz	LB	UB	R2R	RCU/RCC	RCU	RCC
Channel Selective	**Standard**											**Fixed wl**
GSM 900	AR1700/0	X	X	X	X				X			X
RGSM 900	AR1700/8	X	X	X	X				X			
EGSM 900	AR1700/9	X	X	X	X				X			
DCS 1800	AR2100/0	X	X	X	X		X		X			X
GSM 1900	AR3100/0	X	X	X	X		X		X			X
CDMA 1900	AR3500/0	X	X				X		X			X
CDMA 1900 2 CH HP	AR3530/0	X					X		X			X
CDMA 800 2 CH	AR4500/0	X	X						X			X
CDMA 800 2 CH HP	AR4540/0	X							X			X
WCDMA 2 CH	AR6500/0	X	X						X			
WCDMA 2 CH HP	AR6560/0	X							X			
Band Selective	**Standard**											
900 BS	AR1200/0					16.5	25			X		X
1800 BS	AR2200/0					16.5		X		X		X
1900 BS	AR3400/0					16.5		X		X		X
1900 BS CDMA	AR3400/5					16.5		X		X		X
800 BS	AR4200/0					16.5	25			X		X
800 BS CDMA	AR4200/5					16.5	25			X		X
800 BS iDEN	AR4600/0					16.5				X		
Band Selective	**Compact**											
900 BS	ALR1200/0					15	25			X	X	
1800 BS	ALR2200/0					15		X		X	X	
1900 BS	ALR3200/0					15		X		X	X	
800 BS	ALR4200/0					15	25			X	X	
800 BS iDEN	ALR4600/0					15				X	X	

Repeater Solutions

Today's network operators are concerned about operating costs, revenues and the pay-off periods for their investments. With this in mind, the optimal solution is obvious. The solution is Repeaters. The lowest total cost is generally related to a mix of technologies. The Repeater gives you the optimal solution.

overview

product overview



Distributed capacity
An airport has areas that need high capacity only at certain peak periods – upon the arrival, when people are waiting for baggage, taxi, etc. To increase the trunking efficiency of the system, the solution should have a powerful base station that distributes capacity to a number of Repeaters for further coverage.

Optimized capacity and extended coverage
By using Repeaters, you avoid having to over-dimension coverage, for example in sparsely populated areas. And if the need for more capacity arises in the future, you can easily replace the Repeater with a base station and then re-use the Repeater in another low capacity area.

Low infrastructure costs
Repeaters are easy to install and require no expensive transmission equipment and less expensive site equipment.

Multiband system
More and more network service providers operate different systems and aim at re-using as much as possible of their infrastructure. Examples are AMPS/CDMA800, AMPS/TDMA800, CDMA 800/CDMA1900, TDMA800/TDMA1900, TDMA 800/GSM1900 and GSM 900/GSM1800. A transition to 3G will accentuate this trend even more.

Multi-operator requirements
In subways and similar situations, two or more network operators may have to share Repeater equipment with the subway or railway operator.

Management
Repeaters, as well as other network products, must be controlled in a professional way to ensure high system availability and reliability. Our Operation and Maintenance System (OMS) is an excellent tool for controlling the entire Powerwave Repeater product range.

GSM 900/1800/1900 EGSM 900 and RGSM 900

Channnel and Band Selective Repeaters

for 900/1800 and 1900 MHz frequency bands

repeaters

product overview

Typical Repeater Characteristics

GSM 900	Channel-Selective AR1700 Family	Band-Selective AR1200 Family
Frequency band UL	890-915 MHz	890-915 MHz
Frequency band DL	935-960 MHz	935-960 MHz
No. of channels	1-8	----
Filter Bandwith	200 KHz	0.5-16.5 MHz* (remote adjustable)
Output power	+33 dBm RMS	+29 dBm PEP (+26 dBm RMS)
Gain Adjustment in 1 dB steps	50-90 dB	45-85 dB
Gain (max variation)	4 dB	6 dB
Pass band ripple	3 dB	4 dB
Noise figure	5 dB	6 dB
Group delay	5 μs	6 μs

GSM 1800	Channel-selective AR2100 Family	Band-selective AR2200 Family
Frequency band UL	1710-1785 MHz	1710-1785 MHz
Frequency band DL	1805-1880 MHz	1805-1880 MHz
No. of channels	1-8	----
Filter Bandwith	200 KHz	0.5-16.5 MHz* (remote adjustable)
Output power	+33 dBm RMS	+32 dBm PEP (+29 dBm RMS)
Gain adjustment in 1 dB steps	50-90 dB	45-85 dB
Gain (max variation)	4 dB	6 dB
Pass band ripple	3 dB	5 dB
Noise figure	5 dB	6 dB
Group delay	5 μs	6 μs

GSM 1900	Channel-selective AR3100 Family	Band-selective AR3400 Family
Frequency band UL	1710-1785 MHz	1710-1785 MHz
Frequency band DL	1805-1880 MHz	1805-1880 MHz
No. of channels	1-8	----
Filter bandwidth	200 KHz	0.5-16.5 MHz (remote adjustable)
Output power	+33 dBm RMS	+32 dBm PEP (+33 dBm RMS)
Gain adjustment in 1 dB steps	50-90 dB	45-85 dB
Gain (max. variation)	4 dB	6 dB
Pass band ripple	3 dB	5 dB
Noise figure	5 dB	6 dB
Group delay	5 μs	6 μs

EGSM 900	Channel-Selective AR1700/902 Family
Frequency band UL	880-915 MHz
Frequency band DL	925-960 MHz
No. of channels	2
Output power	+33 dBm RMS
Gain Adjustment in 1 dB steps	50-90 dB
Gain (max variation)	5 dB
Pass band ripple	1 dB
Noise figure	3,5 dB
Group delay	<6 μs

RGSM 900	Channel-selective AR1100/802 Family
Frequency band UL	880-915 MHz
Frequency band DL	925-960 MHz
No. of channels	2
Output power	+33 dBm
Gain adjustment in 1 dB steps	50-90 dB
Gain (max variation)	4 dB
Pass band ripple	1 dB
Noise figure	5 dB
Group delay	<6 μs

Combi/Dual-band/Dual-cell

Different combinations in standard housings are available, see example below.

	Frequency	Remark
AR1712	900/900	Combi-model Channel and Band-Selective
AR2117	1800/900	Dual-band Channel-Selective

*25 MHz as option

Mechanical Specification see Page 18

CDMA (IS-95) Repeaters
for CDMA 800 and 1900 MHz frequency bands

repeaters

product overview

Typical Repeater Characteristics

Channel-Selective

CDMA	AR3500 Family	AR4500 Family
Frequency band reverse Link	1850-1910 MHz	824-849 MHz
Frequency band forward Link	1930-1990 MHz	869-894 MHz
No. of channels	1-4	1-4
Filter bandwidth	1.23 MHz	1.23 MHz
Output power standard	+33 dBm RMS	+33 dBm RMS
Output power high-power	+38 dBm RMS	+38 dBm RMS
Gain adjustment in 1 dB steps	50-90 dB	50-90 dB
Gain (max. variation)	4 dB	4 dB
Pass band ripple	3 dB	3 dB
Noise figure	5 dB	5 dB
Group delay	5 μs	5 μs

Band Selective

CDMA	AR3400 Family	AR4200 Family
Frequency band reverse Link	1850-1910 MHz	824-849 MHz
Frequency band forward Link	1930-1990 MHz	869-894 MHz
Filter bandwidth (remote adjustable)	0.5-16.5 MHz*	0.5-16.5 MHz*
Output power standard	+36 dBm RMS	+33 dBm RMS
Gain adjustment in 1 dB steps	45-85 dB	45-85 dB
Gain (max. variation)	6 dB	6 dB
Pass band ripple	5 dB	5 dB
Noise Figure	6 dB	6 dB
Group delay	6 μs	6 μs

Combi/Dual-band/Dual-cell

Different combinations in standard housings are available, see example below.

	Frequency	Remark
AR3535	1900/1900	Combi-model with 4 channels in same housing
AR4545	800/800	Combi model with 4 channels n same housing
AR3545	1900/800	Dual-band/dual-cell with 4 channels in same housing

*25 MHz as option
Mechanical Specification see Page 18

WCDMA
Channnel Selective Repeaters
for 2100 MHz frequency bands

repeaters

product overview

Typical Repeater Characteristics

WCDMA	Channel-Selective AR6500 Family
Frequency band UL	1920-1980 MHz
Frequency band DL	2110-2170 MHz
Number of channels	1-2
Filter bandwidth	5 MHz
Gain adjustment in 1 dB steps	55-90 dB
Absolute group delay	6 μs
Output power (DL) RMS, one WCDMA carrier, standard (AR6500)	+30 dBm
Output power (DL) RMS, one WCDMA carrier, high power (AR6560)	+38 dBm
Output power (UL) RMS, one WCDMA carrier	+20 dB
Pass band ripple within 4,0 MHz	2 dB
Gain variation at 80 dB gain, over freq. band	4 dB
Noise figure at max gain, 25° C	3 dB

Combi/Dual-band/Dual-cell

Different combinations in standard housings are available, see example below.

	Frequency	Remark
AR6565	2100/2100	Combi model with 4 channels in same housing
AR6521	2100/1800	Dual band 2 channel GSM 1800 and 2 channel WCDMA
AR6517	2100/900	Dual band 2 channel GSM 900 and 2 channel WCDMA

Mechanical Specification see Page 18

TDMA/AMPS/iDEN®
Band Selective Repeaters
for 800 and 1900 MHz frequency bands

repeaters

product overview

Typical Repeater Characteristics

TDMA	Band Selective AR3400 Family
Frequency band UL	1850-1910 MHz
Frequency band DL	1930-1990 MHz
Filter bandwidth (remote adjustable)	0.5-16.5 MHz*
Output power	+36 dBm PEP (+33 dBm RMS)
Gain adjustment in 1 dB steps	45-85 dB
Gain max. variation	6 dB
Pass band ripple	5 dB
Noise figure	6 dB
Group delay	6 μs

AMPS	Band Selective AR4200 Family
Frequency band UL	824-849 MHz
Frequency band DL	869-894 MHz
Filter bandwidth (remote adjustable)	0.5-16.5 MHz*
Output power	+36 dBm PEP (+33 dBm RMS)
Gain adjustment in 1 dB steps	45-85 dB
Gain max. variation	6 dB
Pass band ripple	5 dB
Noise figure	6 dB
Group delay	6 μs

iDEN	Band Selective AR4600 Family
Frequency band UL	UL 806-824 MHz
Frequency band DL	DL 851-869 MHz
Filter bandwidth (remote adjustable)	0.5-16.5 MHz
Output power	+36 dBm PEP (+33 dBm RMS)
Gain adjustment in 1 dB steps	45-85 dB
Gain max. variation	6 dB
Pass band ripple	5 dB
Noise figure	6 dB
Group delay	6 μs

Combi/Dual-band/Dual-cell
Different combinations in standard housings are available, see example below.

	Frequency	Remark
AR4242	800/800	Combi model with 2 band-selective sections in same housing
AR3434	1900/1900	Combi model with 2 band-selective sections in same housing
AR3442	1900/800	Dual-band/dual-cell with 2 band-selective sections in same housing

*25 MHz as option
Mechanical Specification see Page 18.

iDEN is a registered trademark of Motorola.

Compact Repeaters

repeaters

product overview

Volumes of mobile telephone traffic is increasing in places such as shopping malls, sports facilities, parking garages, museums, on board trains, stations, airports and offices. Environments of this type are complex and present major challenges in terms of capacity and coverage. Network operators have a lot to gain in terms of image and revenue by being prompt in offering solutions which effectively satisfy user's demands for operational availability.

The Powerwave Compact Repeater is a cost-effective product thanks to its modular design, professional monitoring tools and great reliability. A solution which will prove over time to offer low operating and maintenance costs. A system with low TCO (Total Cost of Ownership).

Indoor Coverage

The challenge is to provide radio coverage in a flexible and efficient way. Among other things with reference to the design, it can be difficult to spread coverage all the way into side isles, narrow hallways, several storys, combined with different building materials. Moreover, if there are many people constantly moving, for instance in shopping malls, and the demand for coverage varies from one spot to another, as well as during the day and during the week, satisfying the growing demand for capacity becomes a challenge. A distributed antenna system based on the Powerwave Compact Repeater concept, combined with an optimized radio base station, provides a homogeneous coverage in a complex environment in a cost effective manner.

If you add Powerwave's ingenious and advanced monitoring tool OMS (Operations & Maintenance System), it keeps down costs related to frequency planning, service, and maintenance throughout the system's life cycle.

The Compact Repeater

The Compact Repeater is built on the same concept as Powerwave's already well-known repeater products, which are noted for their advanced technology, flexibility and high quality. The generic design permits a wide range of products in the 800 to 2100 MHz frequency bands. The current program covers GSM 900/1800/1900, TDMA 1900 and AMPS/iDEN. The Compact Repeater product range will also cover UMTS.

The Powerwave Compact Repeater comprises the well-proven adjustable filter design, which allows the operation to remotely adjust the filter bandwidth to specific site conditions.

In addition to its small size and low weight, the Compact Repeater is easy to install, operate and maintain. For some specific environments the Compact Repeater could be considered as an alternative to the high-power output Powerwave Repeater, thus offering a cost-effective solution. It's modular design means that the installed repeater can be upgraded with additional bands at a relatively low cost.

Band Selective Compact Repeaters

repeaters

product overview

Typical Repeater Characteristics

GSM 900/1800/1900	Compact Repeater ALR1200 Family	Compact Repeater ALR2200 Family	Compact Repeater ALR3200 Family
Frequency band UL	890-915 MHz	1710-1785 MHz	1850-1910 MHz
Frequency band DL	935-960 MHz	1805-1880 MHz	1930-1990 MHz
No. of channels	---	---	---
Filter Bandwidth	0.5-15.0 MHz* (remote adjustable)	0.5-15.0 MHz* (remote adjustable)	0.5-15.0 MHz* (remote adjustable)
Output power	+25 dBm PEP	+26 dBm PEP	+28 dBm PEP
Output power (TDMA-RMS)	+22 dBm	+23 dBm	+25 dBm
Gain adjustment in 1 dB steps	55-70 dB	55-70 dB	55-70 dB
Gain (max variation)	5 dB	5 dB	5 dB
Pass band ripple	4 dB	4 dB	4 dB
Noise figure	8 dB	8 dB	8 dB
Group delay	6 μs	6 μs	6 μs

TDMA/AMPS/iDEN/CDMA	Compact Repeater ALR3200 Family	Compact Repeater ALR4200 Family	Compact Repeater ALR4600 Family
Frequency band UL	1850-1910 MHz	824-849 MHz	806-824 MHz
Frequency band DL	1930-1990 MHz	869-894 MHz	851-869 MHz
Filter Bandwidth	0.5-15.0 MHz* (remote adjustable)	0.5-15.0 MHz* (remote adjustable)	0.5-15.0 MHz (remote adjustable)
Output power	+24 dBm PEP	+24 dBm PEP	+28 dBm PEP
Output power (TDMA-RMS)	+25 dBm	+25 dBm	+25 dBm
Output power (CDMA-RMS)	+24 dBm	+24 dBm	---
Gain adjustment in 1 dB step	55-70 dB	55-70 dB	55-70 dB
Gain (max variation)	5 dB	5 dB	5 dB
Pass band ripple	4 dB	4 dB	4 dB
Noise figure	8 dB	8 dB	8 dB
Group delay	6 μs	6 μs	6 μs

EGSM 1200/901	Compact Repeater ALR1200/901 Family
Frequency band UL	880-915 MHz
Frequency band DL	925-960 MHz
No. of channels	---
Output power	+25 dBm PEP
Gain adjustment in 1 dB steps	55-70 dB
Gain (max variation)	5 dB
Pass band ripple	5 dB
Noise figure	8 dB
Group delay	6 μs

Compact Repeater ALR6200 Family
1920-1980 MHz
2100-2170 MHz
5-15 MHz
(remote adjustable)
+24 dBm RMS DL
+20 dBm RMS UL

55-70 dB
5 dB
4 dB
3 dB
6 μs

*25 MHz as option
Mechanical Specification see Page 18

Combi/Dual-band/Dual-cell

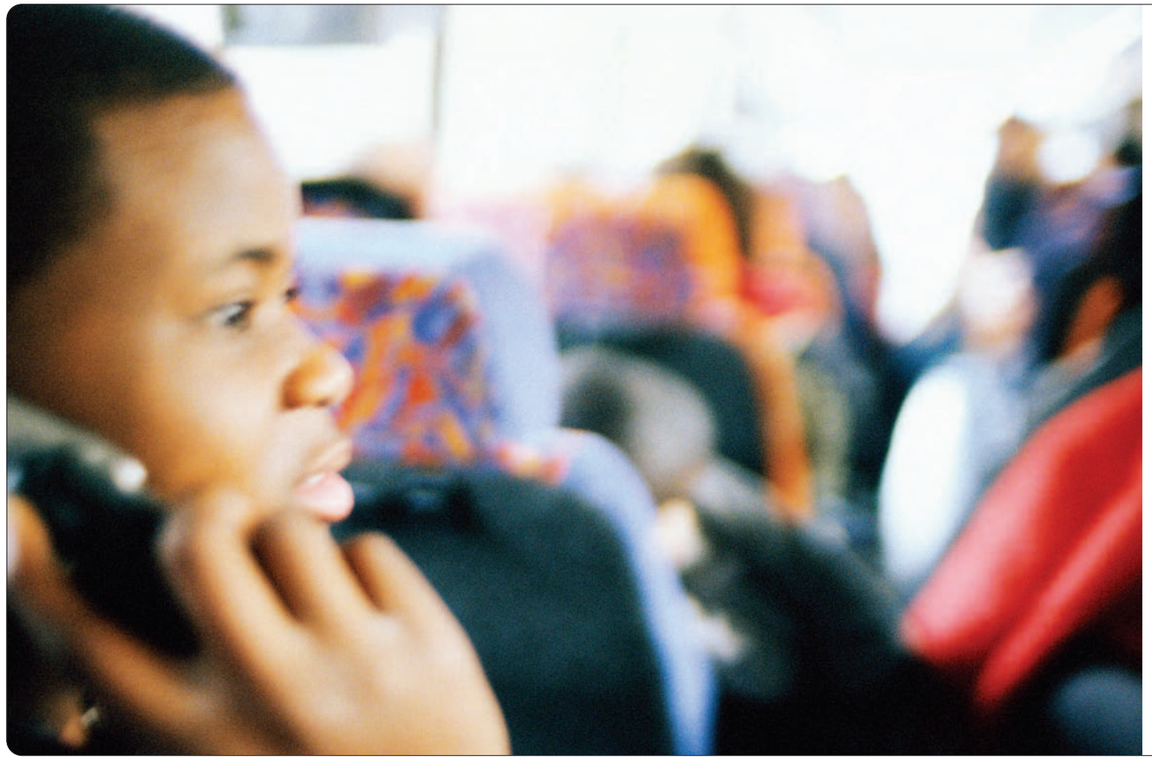
Different combinations in standard housings are available, see example below.

	Frequency	Remark
ALR3242	1900/800	Combi model with 2 band-selective sections in same housing
ALR2212	1800/900	Combi model with 2 band-selective sections in same housing
ALR2222	1800/1800	Dual-band/dual-cell with 2 band sections in same housing

Mechanical Specifications

specs

optimize



Standard Repeaters		1-4 channels	5-8 channels	High power CDMA	Dual band
Dimension	mm	440 x 530 x 195	440 x 530 x 280	440 x 530 x 280	440 x 530 x 280
	inches	17.4 x 20.9 x 7.7	17.4 x 20.9 x 11	17.4 x 20.9 x 11	17.4 x 20.9 x 11
Weight	kg	22.5	37	37	37
	lbs	50	82	82	82

Compact Repeaters	Compact low	Dual band
Height mm/inches	385/15.2	385/15.2
Width mm/inches	385/15.2	385/15.2
Depth mm/inches	110/4.3	160/6.3
Weight kg/lbs	10/22	20/44

Our products meet mobile cellular industry standards and comply with the following:

R&TTE Directive 1999/5/EC

Environmental

ETS300 019-2-4, class T4.1E: Stationary use at non-weather-protected locations, extended climatic tests.

Radio transmission and reception

- ETS300 577, GSM05.05: Radio transmission and reception and ETS300 609-4, part 4
- ETS300 609-4, part 4
- EMC emission and immunity ETS 300 342-3 ETS 301 489-1
- EMC immunity IEC 801-2, 4 and 5
- FCC rule 15, 22, 24 and 90
- ETS TS 25.143
- ETS TS 25.113

Relevant products fulfill the US emission requirements according to the Federal Communications Commissions and Industry of Canada specification RSS133 issue 1.

Repeater Safety

- IEC Publication 65
- ETL recognition according to UL 1950 3rd Edition
- cUL recognition according to CAN/CSA C22.2 950-95
- Fiber-optic safety according to US Food and Drug Administration part 1040.10, 1998
- IC RSS 133 Issue 1

Fiber Optic Repeaters

Powerwave fiber optic repeaters are fed with cellular signal over optic fiber instead of over coaxial cables or from the air interface. The Fiber Optic Unit (FOU) is the generic interface that fits all Powerwave design platforms. The FOU is a high performance, high dynamic unit, which converts the RF-signals to lightwave signals (and vice versa) and distribute the RF signal over the fiber with far lower loss than coaxial cable.

fiber optic

product overview

Special Features

- Long distance operation over single mode fiber
- Adjustable gain for link optimizing
- Combined fiber operation by using WDM
- Full remote control of fiber optic repeaters
- Easy commissioning with Windows-based terminal software
- Alarm set-up and operation fully compatible with OMT and OMS software

The basic building block of the network is the transceiver board called Fiber Optic Node (FON). It is used as a sub-assembly in the FOU which can be installed in any Powerwave repeater, or as a stand-alone board in our Base Station Master Unit (BMU) or in LINDAS.

The FON performs the conversations between RF signal and light and vice versa. The FON also includes a sub-carrier to be used for data communication (fiber-to-fiber) between different nodes in the fiber optic network. This feature enables the operator to have full remote control of the fiber optic repeater (or several) from only one access point. The sub-carrier frequency is chosen so it has no effect on the cellular 800-2200 MHz frequency band.

The distribution system is built up by a master unit and one or several fiber optic repeaters. The system allows for the master unit to be fed with a signal either directly from the BTS or through the air. The fiber optic repeater can distribute the received signal to the other co-located repeaters.

A single FOU can provide optical signal to a maximum of four other FON's and the system is thus often built in either star or chain topology. Multiple nodes can be used in a master unit to facilitate large distribution systems. In order to reduce the number of fibers required by the system, wavelength division multiplexing can be utilized to allow the same fiber to be used for both up and downlink.

The Powerwave fiber optic distribution system can be seamlessly integrated into Powerwave single-use or multi-use Operation and Maintenance System (OMS), which provides full access to all repeaters.

System building blocks

The Powerwave Fiber Optic Distribution System consists of two basic types of equipment. On one side is the Master Unit either conected to the Base station over a coaxial link or over an air link. On the other side the fiber is connected to the fiber optic repeaters and converts the optical signal to RF for further distribution to the service area.

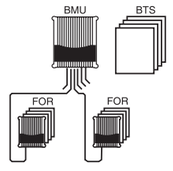
The system can in realtime be controlled from the Powerwave Operation & Maintenance Terminal (OM-Online) software or by the more sophisticated batch controlled Operation & Managment System (OMS).

BMU-Basestation Master Unit

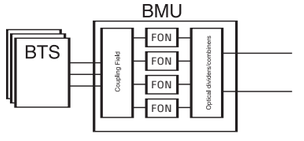
The standard Master Unit is used when the Fiber Optical system is fed with RF signal directly from one or more BTS's over coaxial cable. The BMU consists of a coupling field, a number of FON's and an optical dividers/ combiners network. The coupling field combines the different signals from different BTS's and passes the combined signal to the Fiber Optic Nodes. The optical dividers/combiners are used after the FON to provide up to four outputs per node. It can also include Wavelength Division Multiplexing Modules, when uplink and downlink are sharing the same fiber.

RMU- Repeater Master Unit

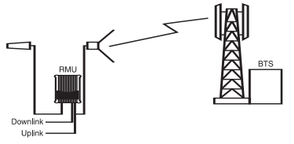
The Repeater Master Unit is used when the distance from the BTS is too long to feed the Fiber Optic Distribution System with signal via coaxial cable. A standard Powerwave Repeater is then used to provide the donor signal to the Master Unit. Several repeaters can be used to provide the donor signal if the distribution system is to handle multiple bands and/or operators.



Typical Fiber Optic Distribution System



Basestation Master Unit



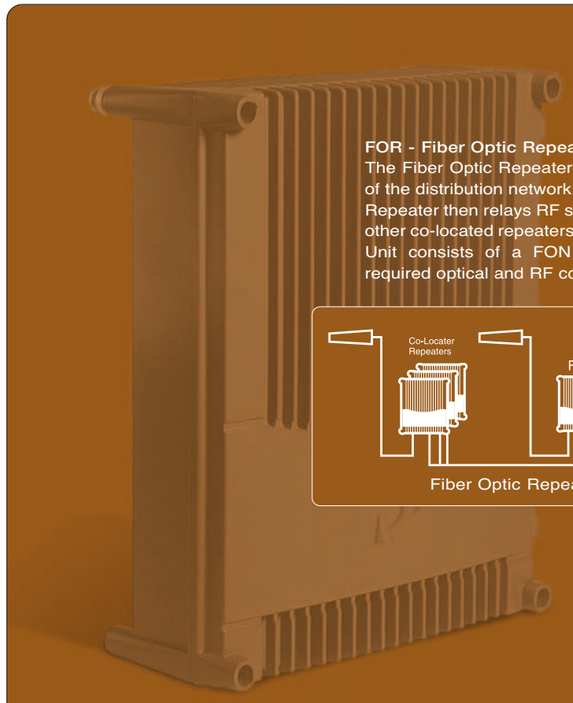
Repeater Master Unit

Fiber Optic Repeaters

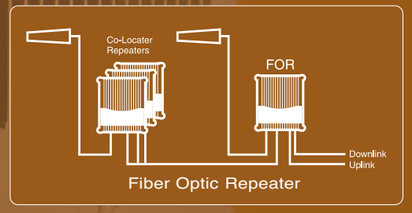
The Fiber Optic Repeater is a standard Powerwave Repeater of any type fitted with a Fiber Optic Unit.

fiber optic

product overview



FOR - Fiber Optic Repeater
The Fiber Optic Repeater is the other half of the distribution network. The Fiber Optic Repeater then relays RF signal to and from other co-located repeaters. The Fiber Optic Unit consists of a FON board and the required optical and RF combiner network.



Fiber Optic Repeater

Fiber-to-Fiber (F2F) network
The traditional way to remote monitor/control the fiber optic repeaters is to include remote radio modems in each repeater. The Powerwave F2F link enables the feature to do the same but from only one access point.

The fiber optic systems different FON's are connected in a network over the fiber. The remote control data from the BMU/FON is sent to the fiber optic repeater FON's, which address the tasks to the repeater subunits. The communication is standard UDP/IP for adressing each node in the network. Both local and remote port can be used at the same time on one or more nodes (Repeater or FON). This means that onsite trouble shooting or set-up parameter modifications can be done at the same time as the OMS performs the normal activities.

Electrical Specification FON

Common

Bandwidth @ 3 dB*	800-2200 MHz
Power consumption, total	<5 W

Transmitter

Laser optic wavelength	DFB 1310 or 1550 nm
Max continous RF input	+36 dBm
Optical output power, two levels	+3/0 dBm
RF attenuation settable by SW in 1 dB steps	0-20 dB

Receiver

Optic Wavelength	1250-1600 nm
Max optic power input	+5 dBm
RF attenuation settable by SW in 1 dB steps	0-20 dB
Alarm threshold level, settable warning	0-40 dBm
Alarm threshold level, settable error	0-40 dBm

* The Fiber Optic Node is connected to a duplexfilter, thus limiting useful bandwidth to cellular standard in use.

Declaration of Conformity

– Environmental Specification	ETS300 019-2-4
– EMC emission and immunity	ETS300 342-3
– Electrical safety	IEC/EN 60825-1 IEC/EN 60950
– US Food and Drug Administration requirements	1040.10 1998

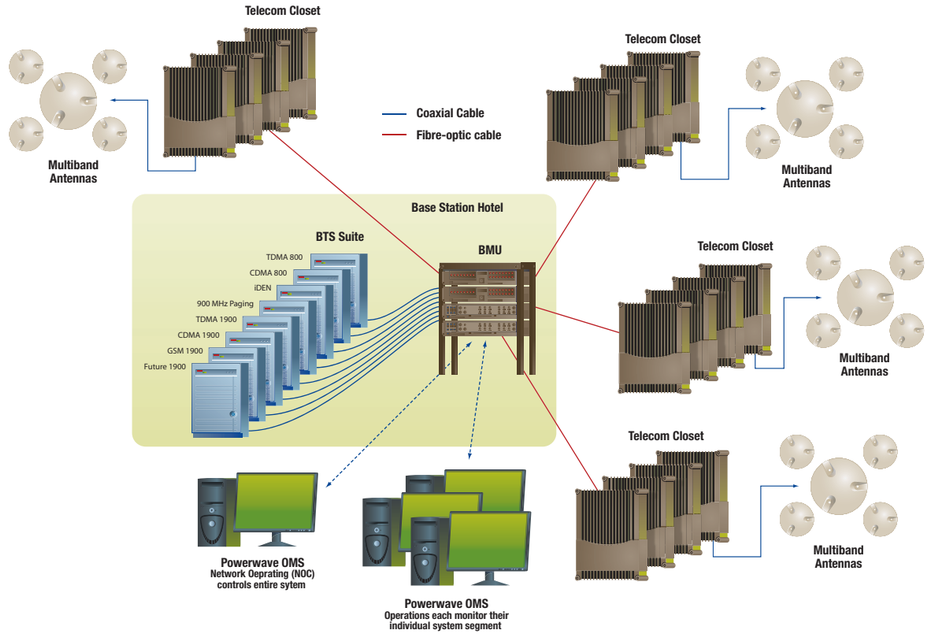
Multi-operator
and multiband DAS
in a scalable RF and IP network

network

cellular coverage

Expandable to accommodate all future cellular technologies, the Moscone Center Distributed Antenna System (DAS) currently supports CDMA, TDMA, EDGE, WCDMA GSM and iDEN as well as SMR operations using 150, 450 and 806-851 MHz frequencies. All system capacity resources are colocated in base station hotels, which house BTS and Base Station Master Units (BMU). A BMU comprises the Point of Interconnect (POI), where all RF signals are combined, and the Optical Conversion Unit (OCU), which converts RF signals into optical light. Optical signals are distributed to remote units via fiber-optic cable.

Powerwave technology requires only a single common fiber for each remote unit. At the remote units, the optical signal is converted back to RF, then amplified separately for each operator. Installed in non-public areas, the remote units are scalable, with a separate amplifier for each individual operator. After filtering and amplification, RF signals are combined and fed to a common multiband antenna system. All active network parts are remote-controlled via an IP network.



solutions

Why Powerwave Repeaters?

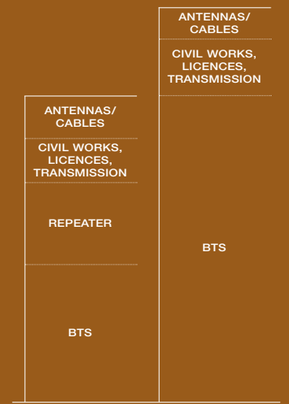
Indoor Coverage

Repeater advantages

- The repeater solution uses the capacity dynamically.
- The repeater solution can handle higher peak load.
- The repeater solution is offering a higher channel utilization.
- The repeater solution is easier to install.
- The repeater solution requires only one BTS with temperatue controlled shelter/room.
- The repeater solution requires only one transmission line from BTS.
- The repeater solution can easily be used in multi-band and multi-operator environments.

Capital outlay

The capital outlay between the described solutions is lower in the repeater case due to only one BTS is used. Costs for transmission, BSC connection and installations are also reduced. The repeater solution will add costs on antenna and feeder but will overall be the most cost effective solution.



Capital outlay repeater solution vs BTS solution

Powerwave is offering a wider range of repeater products in the 800 to 2100 MHz frequency range. The products are based on a generic design platform, wellknown for high modularity, quality and reliability. Repeaters and other network products must be controlled in a effecient way to ensure high system availability and reliability. The Powerwave Operation and Maintenance System, OMS, is an advanced software platform from which current and future Powerwave Repeaters can be monitored and controlled. Furthermore the OMS can be integrated into an overall operation and maintenance system.

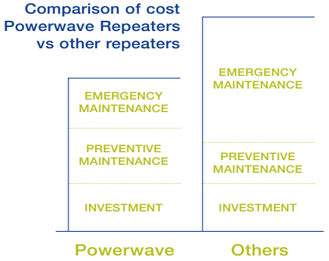
By using the OMS tool you will be able to handle a fleet of repeaters in a multi-user environment with simultaneous data access and high system security.

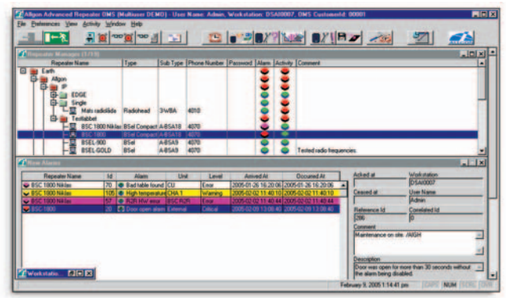
The OMS is a complete management system featuring:

- Multi-user operation
- Multi-modem operation
- Alarm handling
- External alarm transfer
- Traffic statistics
- Complete security

The system has well-developed functions for Operation and Preventive Maintenance, and requires significantly less Emergency Maintenance. Due to Powerwave's advanced management system the TCO for the Powerwave Repeater solution is far more favorable.

Comparison of cost Powerwave Repeaters vs other repeaters





An intuitive graphical user interface provides excellent overview and simplifies usage.

Wideband Radio Head
for SMR 800/900 MHz DAS Networks

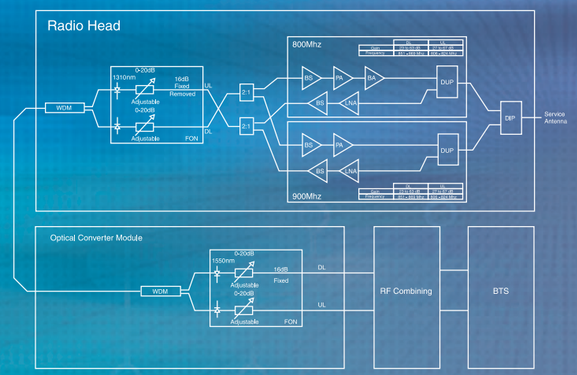
800/900 MHz

product overview

The Powerwave Remote Radio Head is intended for use in DAS (Distributed Antenna Systems) for the distribution of RF signals in dense urban and residential areas, tunnels, subways, airports and buildings where there is a need for a high quality and cost efficient coverage solution. This solution is based on a modular design, providing support for various combinations of frequency bands and output power classes. Each node has its own IP address enabling the Remote Radio Head network operator easy monitoring and management, utilizing the proven and user-friendly Windows-based Operation and Maintenance System (OMS) by Powerwave.

Features/Benefits:

– Fiber optic distribution
– Multi band capability
– Modular design
– Remote control option
– Integrated power supply
– IP65 rating



LYGN 11-14-04

Product Specifications

Electrical Specifications

Frequency Range	896-901 MHz (Uplink) (SMR 900) 935-940 MHz (Downlink) (SMR 900) 806-824 MHz (Uplink) (SMR 800) 851-869 MHz (Downlink) (SMR 800)
Output Power (@ -13 dBm IMD)	
– 900 MHz	@ 8 ch + 27 dBm/ch. (RMS) @ 16 ch + 18 dBm/ch. (RMS)
– 800 MHz	@ 8 ch + 27 dBm/ch. (RMS) @ 16 ch + 18 dBm/ch. (RMS)
Gain Adjustment Range	30 dB
Gain Step Resolution	1 dB
Gain Variation	< 2 dB
Max absolute delay	< 300 ns
System Noise Figure	4 dB (includes fiber optic node)
Input IP3 Uplink (max gain)	- 25 dBm
Maximum RF input uplink	+ 13 dBm (non destructive)
Return Loss	14 dB
Output IP3 Downlink	+ 54 dBm + 60 dBm (HP Option)
Uplink AGC	≥30 dB
Downlink AGC	≥30 dB
Power Supply	110/230VAC
Power Consumption	110W/160W (std./HP)

Note: Power rating includes duplexer loss.

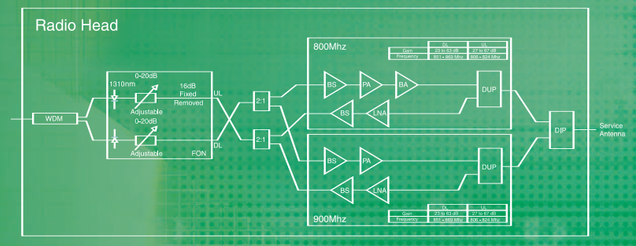
Wideband Radio Head
for SMR 800/900 MHz DAS Networks

800/900 MHz

product overview

Product Specifications

Mechanical Specifications	
Dimensions (WxHxD)	17.4" x 20.9" x 7.7" / 440mm x 530mm x 280mm
Weight	50 lbs / 22.5 kg
RF Connectors	N-type female or DIN 7/16 female
Fiber connectors	FC-APC, other options available
Operating temperature	-25°C to +55°C / -13°F to +130°F
Remote Cabinet	IP65, cast, convection cooling
Summary Alarm contact	Normally closed (open during alarm)

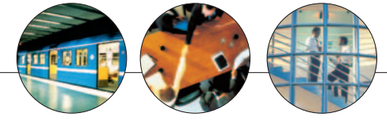


Product Specifications

General Specifications	
Alarm management	OMS
Sample Listing:	
– Power failure	
– Low optical power	
– Over temperature failure	
– Communication failure	
– Intruder alarm (optional)	
Performance Management	OMS/OM-Online
– Output power	
– Optical power levels	
– Communication status	
– Alarm status	
Configuration Management	OMS/OM-Online
– Gain settings	
– Communication settings	
– AGC settings	

All specifications are subject to change without notice.

Contact your Powerwave representative for complete performance data.



about Powerwave

Please contact your Powerwave representative for more information or go to our website at www.Powerwave.com.

The Powerwave Product And Solution Suite:

ANTENNA SYSTEMS

Clean Sites

Antennas
- Antenna Brackets
- Remote Electrical Tilt

Filters

Tower Mounted Amplifiers
- Current Injectors
- Power Distribution Units

BASE STATION SYSTEMS

Power Amplifier Products
- Multi-Carrier Power Amplifiers

RF Conditioning Products
- Base Station Filters
- Microwave Filters

Integrated Radio Products
- Digital Radio Head

COVERAGE SYSTEMS

MCPA Booster Systems

Repeater Systems

Coverage System Innovations
- Coverage Engineering and System Design
- Indoor and Outdoor Coverage Products
- Complete Solutions
- Multiband Indoor Antennas
- Amplifiers
- Repeater Systems
- Distribution Products
- Network Management and Services

Microwave Link Systems

One global source for wireless communications

Powerwave Technologies stands as a single, powerful, global supplier of end-to-end wireless infrastructure solutions, with a proven history. Our expanded portfolio is as broad and deep as any in the industry, ranging from Antenna Systems to Base Station Systems to Coverage Systems. We have resources on-the-ground in over 50 countries and four continents. Powerwave brings together a worldwide network of customer-focused employees and partners, along with combined R&D resources and technology. This gives us the ability to rapidly turn ideas and innovations into cost-effective, real-world solutions that deliver world-class quality and reliability.

Coverage and capacity

In established wireless markets, the trend towards mobile data and increased usage per subscriber will drive demand for more capacity. In addition, coverage enhancements in specialized or challenging environments will be a critical aspect of wireless network growth. In emerging markets, the demand for coverage will most likely override the need for capacity in the near future. Regardless of your market demands, region or technology mix, Powerwave is ready with efficient coverage and capacity solutions. Our leading edge solutions are engineered to deliver the highest quality customer experience for the lowest capital expenditure. And our "future-proof" modular architecture is designed for seamless rollout of next generation 3G technologies.

Technology leadership

As a technology leader, Powerwave invests significant funds in research and development. Our market-driven research approach has brought about a number of innovations, from product advances such as ultra-linear amplifiers to higher-value concepts like Clean Site solutions and Base Station Co-Siting.

Global Partner

Wherever your wireless infrastructure project may be, chances are that local Powerwave resources are close by. In addition, our expanded global manufacturing platform ensures that we can provide high-volume, cost-effective production close to your project sites, speeding delivery and driving down costs.

Integrated solutions

Powerwave is moving the industry forward with integrated solutions that speed up time to market, reduce clutter on the tower, streamline deployment and take efficiency to new heights. For example, by integrating RF conditioning front end subsystems with power amplifiers, we're able to rapidly create downlink solutions that turn conventional thinking upside down. What used to go in the base station can now mount on the mast-closer to the antenna-delivering greater efficiency and higher functionality, reduced power consumption, lower operational costs and longer system life.

Quality and reliability

Powerwave employees are intensely quality-minded and we strive to provide our customers with the most reliable products and services available in the market today. Beyond being both an ISO 9001, TL 9000 and ISO 14000 certified company, Powerwave has earned a reputation in the marketplace with leading OEMs and operators for consistently delivering world-class quality and reliability.

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