



**R&D Group**

**DEKO2489I**  
**Dual band Mini Repeater**  
**PDR**

Revision: A  
 Release Date: 07/11/05  
 Drafted by: Yury A.

REVISIONS				
Rev	ECN No.	Date	Name	Signature
A	Released	07.11.05	Yury.A	

# Dual-Band Mini Repeater

## 800/900MHz

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	DATE	NAME	SIGN	<p align="center"><b>Operation Description</b></p>				
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# **1 Introduction**

## **1.1 Glossary**

For the purposes of the present document, the following abbreviations apply:

DL	Down Link
UL	Up Link
HW	Hardware
SW	Software
LNA	Low Noise Amplifier
PRE	Pre Power Amplifier
CHN	Channeler
PAmp	Power Amplifier
PS	Power Supply
UUT	Unit Under Test
AGC	Automatic Gain Control
MS	Mobile Station
BTS	Base Transceiver Station
EVM	Error Vector Magnitud
RF	Radio Frequency
UARFCN	UTRA Absolute Radio Frequency Channel Number
UMTS	Universal Mobile Telecommunication System
UTRA	Universal Terrestrial Radio Access
CW	Continuous Wave (un-modulated signal)
CDMA	Code Division Multiple Access
GSM	Global System for mobile communications
SMR	Security Mobile Radio
NC	Normal Conditions
EX	Extreme Conditions
CFE	Compact Front End
CFED	Dual band Compact Front End

## 2 General Description

The Dual band mini repeater assembly provides an exceptional repeater to extend the coverage area of radio communications in buildings and in RF shadowed area.

Dekolink's new dual band programmable band selective RF repeaters, employ an advanced up/down conversion Intermediate Frequency (IF) Surface Acoustic Waves (SAW) filtering architecture. This new technology offers distinct advantages over conventional band selective repeaters, when high adjacent selectivity and spectrum purity is required. The use of the technology is required to meet iDEN standard requirements.

Features such as high linearity power amplifiers are contributing for the overall improved system linearity performances. Special design of the wide band power amplifiers and quad duplexer in each side of the repeater enable operation in both 800 and 900 bands of SMR.

Operating band is Rebandable at 800MHz, allowing for future customer needs, even after field installation has been taken place. The repeaters also can be used for multi operator's applications. If required, Dekolink can provide Operation and Maintenance System (RMS), which provides local or remote monitoring and control features.



Figure 1: Dual band Mini Repeater

- Covers both SMR800 & SMR900 in one product.
- Rebandable 800MHz band allowing 18/7MHz.
- Very high out of band rejection.
- Exceptionally high linear operation.
- Smart ALC, for network transparent.
- Remote or local access for control.
- Cost effective.
- Compact design.
- Ideal for in-building coverage solutions.
- Wall mounted easy installation.
- Relatively small size and light weight.

The unit will be based on Mini-Repeater structure includes modified Up/Down converter with active SAW switcher and a new CFED unit.

The CFED unit will be based on a quadra-plexer configuration, which combines 800 MHz and 900 MHz bands. Together with SAW diplexers consist of sharp out of band attenuation SAW filters to achieve better sensitivity and isolation between the receiving and transmitting paths. CFED will consist of 4 LNA and 4 PA routes with an ability between band gain offset calibration.

Using the Up/Down converter each path is down-converted to an Intermediate Frequency (IF) and will be filtered with use of SAW switcher which is configured as Rebandable SAW filter to block out the adjacent band power and to ensure out of band gain according to the iDEN standard, using up/down conversion architecture.

The power amplifiers have power-monitoring circuits (Automatic Level Control - ALC) for output power limitation. The ALC circuit will be based on Dekolink's Smart ALC algorithm for gain control. The downlink power amplifier will include Dekolink's Smart ALC power-monitoring circuits (patent pending) to prevent "cell coverage shrinking" and to limit the output power, while maintaining the power amplifier linearity. The Smart ALC ensures network transparency, auto gain adjustment as well as prevention of oscillations in case of improper installation. The Smart ALC automatically maintains downlink and uplink gain balancing.

The repeater will be housed in a decorative metal moulded enclosure to fit for wall mount as well for easy installation. The enclosure is suitable for indoor environment.

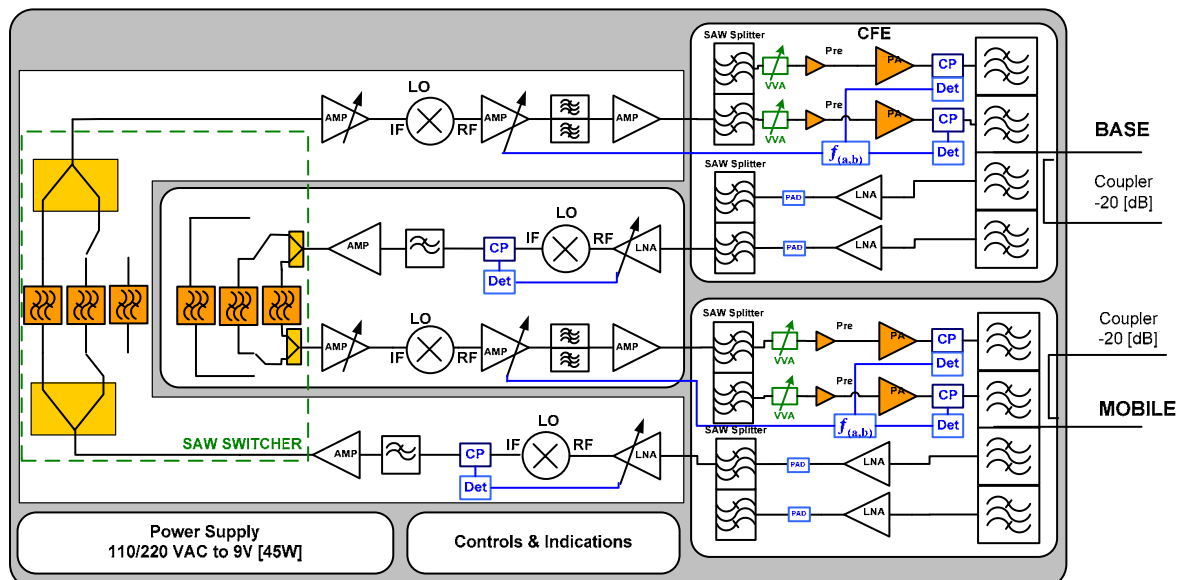


Figure 2: Mini Repeater RF routes

## 3 Design Considerations and Operation Description

The RF routes of UL and DL are quite similar except for customer defined between bands gain offset.

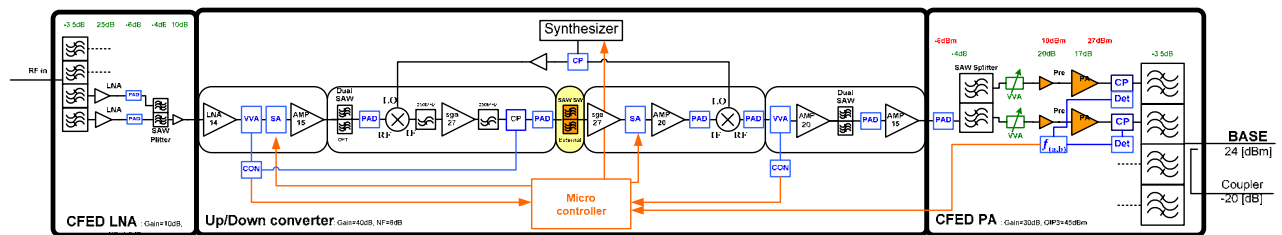


Figure 3: Mini Repeater detailed preliminary Block diagram

### 3.1 Compact Front (CFED\_LNA):

At the input we use a quadra-plexer to separate the bands, to isolate the out of band spectrum to prevent feedbacks and oscillations. Each band RX amplified with separate 1dB NF LNA. The LNA outputs are combined via SAW diplexer which was designed especially for the dual band products. Attenuation pads will be placed immediately after the LNA to provide fine tuning of LNA gain.

### 3.2 Up/Down converter

The Up/Down converter provides gain of up to 45dB (5dB temperature compensation spare). By using up/down conversion architecture the bands are converted separately to IF (Intermediate frequency), filtered to provide adjacent band rejection and then down converted back. The converted signal is once more filtered using dual band filter to reject IMD products and L.O. leakage, and then it is amplifies to reach the desired gain.

### **3.3 SAW Switcher**

The IF filtering is done in the SAW switcher unit, implementing Rebanning feature for 800MHz band, using specially designed sharp out of band suppression SAW filtering technology.

### **3.4 Compact End (CFED\_PA)**

The CFED's post amplifier unit designed to provide composite 24dBm output power or 21dBm per band with OIP3 of 45dBm using linear amplifiers. At the input of the amplification stages, a SAW Diplexer separates the bands in two different pre amplifiers and power amplifiers. Immediately after the SAW Diplexer digital controlled step attenuators provide gain balance for the separated bands, intended to accomplish both, gain balance between bands and costumer defined between bands gain offset. Each band is separately amplified using cascaded high linearity preamplifier and power amplifier. The power amplifiers' outputs are protected from mismatch using isolators. Sample from the outputs are taken for the ALC loop into separate detectors for each output amplifier. The levelling and hence the gain control is made according to the strongest output or the combination of the two outputs to provide 21dBm for each output or 24dBm composite. The amplifiers outputs are combined with the second quadra-plexer which is used to separate the other route's bands for LNA. Output couplers enable -20dB sample for tests and for cascading units.

The control loop will use a two channel I2C standard parallel driver which will be placed at the digital part of the CFED board.

The gain and power balance for two separate bands needs program changes of the Up/Down converter's microcontroller due to the use of separate step attenuators and the combination of the separate detector readings.

### 3.5 New designs/modifications needed

#### CFED and mechanical changes

New PCB design is needed for the CFE. This needs some mechanical modifications for the metal unit housing. At a preliminary design, was made, we can see two of the options for placing and layout of the CFED PCB and the metal housing changes needed:

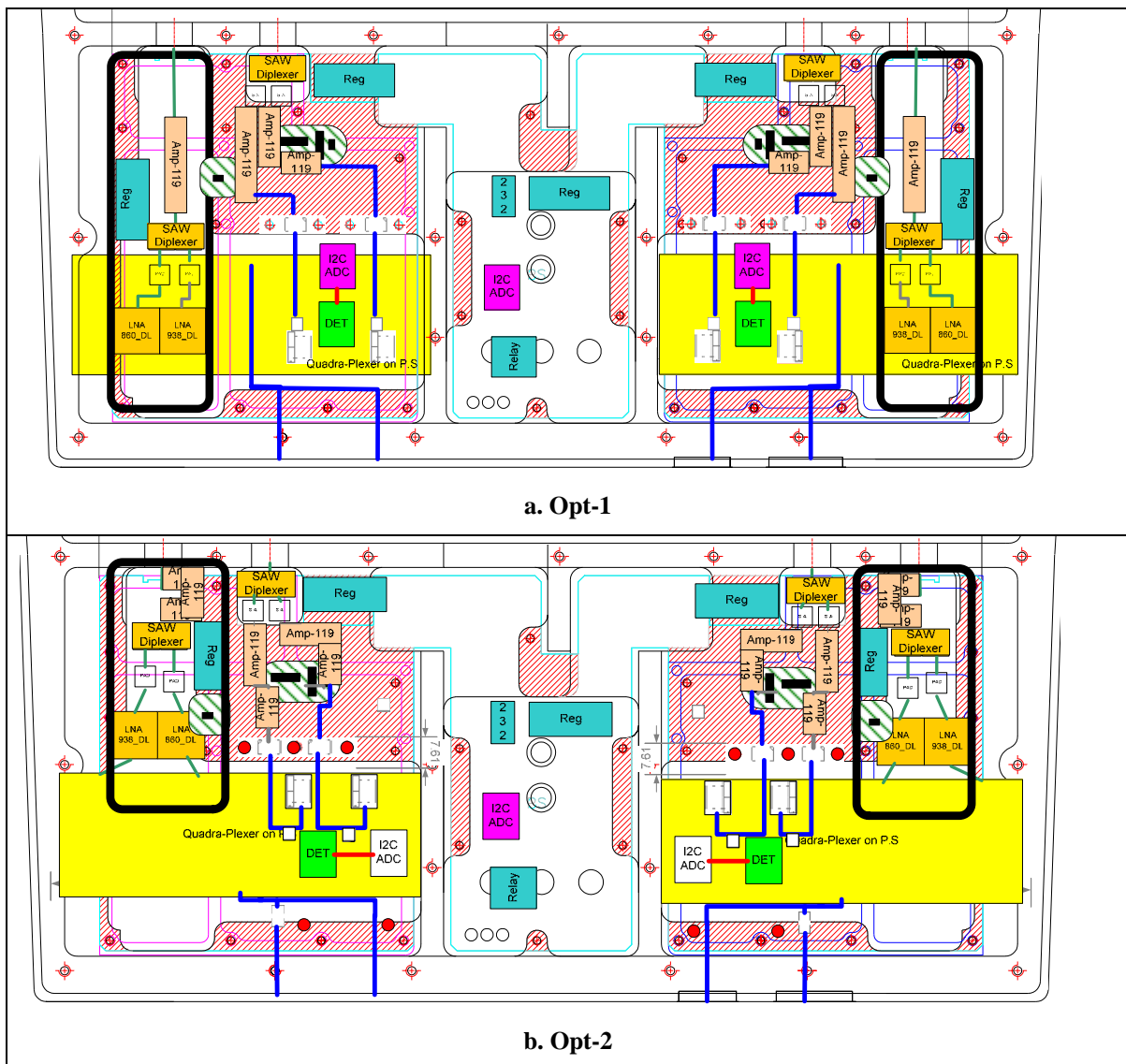


Figure 4: New CFED PCB preliminary design

### **Up/Down converter**

The Up/Down converter needs the filters to be replaced with dual band filters, to meet new demands.

### **Controller's software**

Controller's software needs to change to provide levelling control for the dual band output according to described before needs. Addition of I2C controlled step attenuators at the repeaters end needs new control procedures to be written. Attention has to be paid to the fact that there must be band calibration separately from between band gain offset.

### **Management software**

RMS650 program may need some changes to be made to enable separate band management of alarms and indications and band gain offsets as well as loader changes to enable the calibration mentioned before.

### **Power Supply**

In case of 27dBm composite output, the external power supply may needs to be replaced to one that can supply power of up to 60W. With 24dBm composite the power supply remains the same (45W).



## 4 Specifications

### 4.1 Electrical Specifications

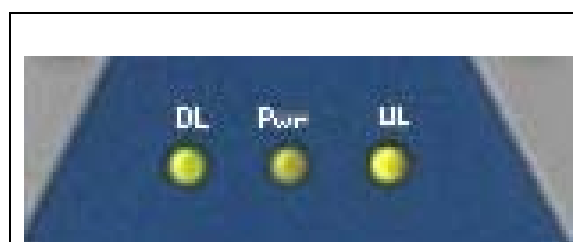
Feature	Uplink		Downlink	
Frequency Range (Full Band)	800[MHz]	900[MHz]	800[MHz]	900[MHz]
	806-824[MHz]	896-923MHz	851-869[MHz]	935-962[MHz]
3 Selectable SAW Filters	18 or 7[MHz]	6[MHz]	18 or 7[MHz]	6[MHz]
Frequency Separation ( In band )	45[MHz]	39[MHz]	45[MHz]	39[MHz]
Max Output Power (composite)	+24 ±1[dBm]			
Max Output Power per band	+21 ±1[dBm]			
Gain @ minimum attenuation	82±2 [dB]			
Auto Gain Control (SALC®)	0 to 30[dB], 1[dB] steps			
Manual Power output control	16 to 24[dBm] in 1[dB] step			
Pass band Ripple per channel	±1.5 [dB p-p] max			
Pass band Ripple all Band	±0.5 [dB p-p] max			
Noise Figure @ max Gain	5 [dB] typical / 7dB[Max]			
Max Input Power (no Damage)	+10[dBm]			
Propagation Delay	<5 microsecond			
VSWR In/Out	1.7: 1 max			
Local Fault Monitor	LEDs indications			
Power supply	110-240 VAC through a supplied power supply 45W			

**Table 1: Electrical Specifications**

\*Channel Center Frequency is Software Programmable

### 4.2 Alarm Specification

Three LEDs are mounted on the mini repeater's front panel. Each one of LEDs may light red, green, orange or blink. At the normal state all LEDs are green. All other combinations of the LEDs according to system status are described in the next table:



**Figure 5: Mini Repeater Indications**



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Alarm	Description
White, Red, Green	Channeler <b>DL</b> over-current problem.
Green, Red, White	Channeler <b>UL</b> over-current problem.
Red Blink, Red, Green	CFE <b>DL</b> Power amplifier Current problem.
Green, Red, Red Blink	CFE <b>UL</b> Power amplifier Current problem.
White, Red, Green	<b>DL</b> L.O lock detect problem.
Green, Red, White	<b>UL</b> L.O lock detect problem.
Orange, Green, Green	<b>DL</b> RSSI problem. Indication clears after power recycle with normal power in.
Green, Green, Orange	<b>UL</b> RSSI problem. Indication clears at normal power in.
Green Blink, Green, Green	<b>DL</b> output power is 8dB less than power set.
Green, Orange Blink, Green	<b>Temperature warning</b> when internally measured temperature is 55°C.
Green, Red Orange Blink, Green	<b>Temperature Alarm</b> when internally measured temperature is 70°C.
Green, Green Orange Blink, Green	<b>Panel mask</b> is on, control enabled only through com port.
Red Orange Blink, Red Orange Blink, Red Orange Blink	<b>User Mute is on</b> , power output is disabled.
Green, Red Orange Blink, Green	System Shut Down.

**Table 2: Alarm indication Specification**

## **4.3 General Specification**

Power Supply	External Power Supply 220/110V AC to 9V DC 45W
Impedance Level	50 [Ohms]
RF Connector	N - Type Female (Mobile & Base ports), SMA (Coupling ports) Female
V.S.W.R	1.7:1

**Table 3: General Specification**

## **4.4 Mechanical and Environmental Specifications**

Storage Temperature	-30 °C to 80 °C
Operation Temperature	-20 °C to 55 °C
Dimension (L X W X H) mm	310x270x70mm (approx. 12.2x10.6x2.8 inch)
Weight	6 Kg (approx. 13.2lb)
Ingress protection (Splash, Dust)	IP-50

**Table 4: Mechanical and Environmental Specifications**

- Specifications are subject to change without notice.