Digital Repeater

Product Manual

Revision 2.0

ABOUT THIS MANUAL

This Product Manual provides the following information:

- A description of the Digital Repeater
- A functional description of the Repeater
- A description of its main modules
- Procedures for setup, configuration and checking the proper functioning of the Digital Repeater
- Maintenance and troubleshooting procedures

TO WHOM IT IS INTENDED:

This Product Manual is intended for experienced technicians and engineers. It is assumed that the customers installing, operating, and maintaining Dekolink Digital Repeaters are familiar with the basic functionality of repeaters.

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SAFETY WARNINGS AND ADMONISHMENTS

Throughout this manual, important safety warnings and admonishments are included to warn of possible hazards to persons or equipment. A safety warning identifies a possible hazard and then describes what may happen if the hazard is not avoided. The safety warnings – in the form of Dangers, Warnings and Cautions must be followed at all times. These warnings are flagged by the use of a warning icon, usually the triangular alert icon seen below. The exclamation point within the triangular alert icon is intended to warn the operator or service personnel of operation and maintenance from factors elating to the product and its operating environment, which could pose a safety hazard.

GENERAL SAFETY WARNINGS CONCERNING USE OF THIS SYSTEM

Always observe standard safety precautions during installation, operation and maintenance of this product. Only a qualified and authorized personnel should carry out adjustment, maintenance or repairs to the components of this equipment.

Danger: Electrical Shock

This equipment is usually installed outdoors. Wet conditions increase the potential for receiving an electric shock when installing or using electrically powered equipment. To prevent electrical shock when installing or modifying the system power wiring, disconnect the wiring at the power source before working with uninsulated wires or terminals.

Caution: RF Exposure

Installation of an antenna must comply with the FCC RF exposure requirements. Refer to paragraph 4.4.

GLOSSARY

The following is a list of abbreviations and terms used throughout this document.

Abbreviation/Term	Definition
AGC	Automatic Gain Control
ALC	Automatic Level Control
ATR	Acceptance Test Report
DAS	Distributed Antenna System
DDF	Dekolink Digital Filter
DL	Dwnlink
Downlink	The path covered from the Base Transceiver Station (BTS) to the subscribers/service area via the repeater
ESD	Electro-Static Discharge
iDEN	Integrated Digital Enhanced Network
IF	Intermediate Frequency
IP3	Third order Intercept Point
MN	Model Number
NMT	Network Management Tool
PLL	Phased Locked Loop
POTS	Plain Old Telephone System
RF	Radio Frequency
RMT	Repeater Management Tool
SALC	Smart-ALC (Automatic Level Control)
SIM	Subscriber Identification Module
SQE	Signal Quality Estimate
UL	Uplink
Uplink	The path covered from the subscribers/service area to the Base Transceiver Station (BTS) via the repeater
VSWR	Voltage Standing Wave Ratio

CONTENTS

1. INTRODUCTION

1.1 GENERAL

Dekolink's Digital Repeaters are channel selective amplifiers that amplify signals bi-directionally between mobile phones and base stations, in cellular and other wireless mobile telephone systems. Dekolink's Digital Repeaters employs advanced Digital Signal Processing (DSP) technology that provides significant advantages over conventional repeaters.

The Digital Repeaters can be monitored locally or remotely via Dekolink's Windows-based Network Management System - RMT software (Refer to the RMT Software User's Guide for more information).

1.2 APPLICATIONS

Dekolink's Digital Repeaters introduce new system capabilities that enable a wide variety of applications particularly when adjacent channel selectivity and/or very high spectral purity are required. The repeaters provide a solution to situations in which flexible, high quality and high resolution filtering methods are necessary.

Dekolink's Digital Repeaters help solve these area coverage problems:

- Capacity enhancement for existing coverage,
- Extended coverage for rural and isolated areas
- Improved in-building coverage
- Frequency shift (FSR), sometimes defined as frequency translation or conversion repeater application
- Hole filler application whenever there is no coverage of a particular spot in the cell site (due to terrain topography or urban structures that shadow areas)
- Cell extension to improve the coverage of an existing cell
- Repeater On Wheels (ROW) application whenever temporary capacity enhancement is requested, as during a major event when large crowds gather

Repeaters also address special application needs such as traffic balancing.

1.3 FEATURES

Some of the of the Dekolink Digital Repeaters' features are listed below:

- 50W Downlink (1dB compression point) output power, i.e., 10W Downlink composite output power
- 90 dB RF gain
- Flexible, software controlled, filter array
- One to eight programmable filters
- Independent programmable bandwidth for each filter (12.5 to 250 KHz)

- High spectral purity
- Local and remote monitor and control (software enabled)
- Relatively small dimensions

1.4 MODELS AND FREQUENCIES

Dekolink's Digital Repeater can be provided in several models, as listed below.

The operating frequency ranges depend on the type and model, as specified in the following table.

Repeater Type	Model Number	Downlink (MHz)	Uplink (MHz)
iDEN / SMR / LMR 800	MW-DBDA-SMR-50W85	851-866	806-821
iDEN / SMR 900	MW-DBDA-SMR-50W90-PS9	935-941	896-902
Public-safety	MW-DBDA-SMR-50W90-PS8	851-869	806-824
NPSPAC	MW-DBDA-SMR-50W90-NPSPAC	866-869	821-824
2 Way Paging	MW-DBDA-SMR-50W90-2PG	928-941	896-902

1.5 UNPACKING AND INSPECTION

This section provides information for unpacking, inspection and preparation for installation.

Examine the shipping container for damage before unpacking the unit. Perform a visual inspection to reveal any physical damage to the equipment.

Verify that the equipment is complete, as listed below and under a packing slip. Contact Dekolink Wireless Ltd if any of this equipment is missing.

Your Dekolink Digital Repeater comes with the following equipment:

- Digital Repeater
- Key (used to lock the repeater case)
- AC cable [6 ft.]
- Alarm cable [6 ft.]
- RS232 cable [6 ft.]
- RMT Software Installation CD
- RMT Software User's Guide and Digital Repeater Hardware Manual (CD and hardcopies)
- Acceptance Test Report (A.T.R.)
- Packaging Box

- Please contact Dekolink if you want to order the following optional equipment:
    - AC Cable [30 ft.] – Long cable for AC power
    - Alarm Cable [30 ft.] – Long cable for External Alarms Input
    - Kit for the iR1200 Modem - Mechanical adaptor for the iR1200 modem installation

2. FUNCTIONAL DESCRIPTION

2.1 GENERAL

This repeater is designed to help improve communications signal and coverage by extending the coverage of a base station. The outdoor Donor (Base) antenna receives the signal from a base station and conveys it to the Digital Repeater. The Repeater amplifies the signal.

After amplification, the signal is passed through to the Mobile antennas, either outdoor or indoor. Conversely, signals from handsets are amplified and retransmitted by the Repeater to the base station.

2.2 FUNCTIONAL DESCRIPTION

The incoming signal processing in the Digital Repeater is processed similarly for both the Uplink and Downlink paths.

Figure 1 provides a functional block diagram of the Digital Repeater.

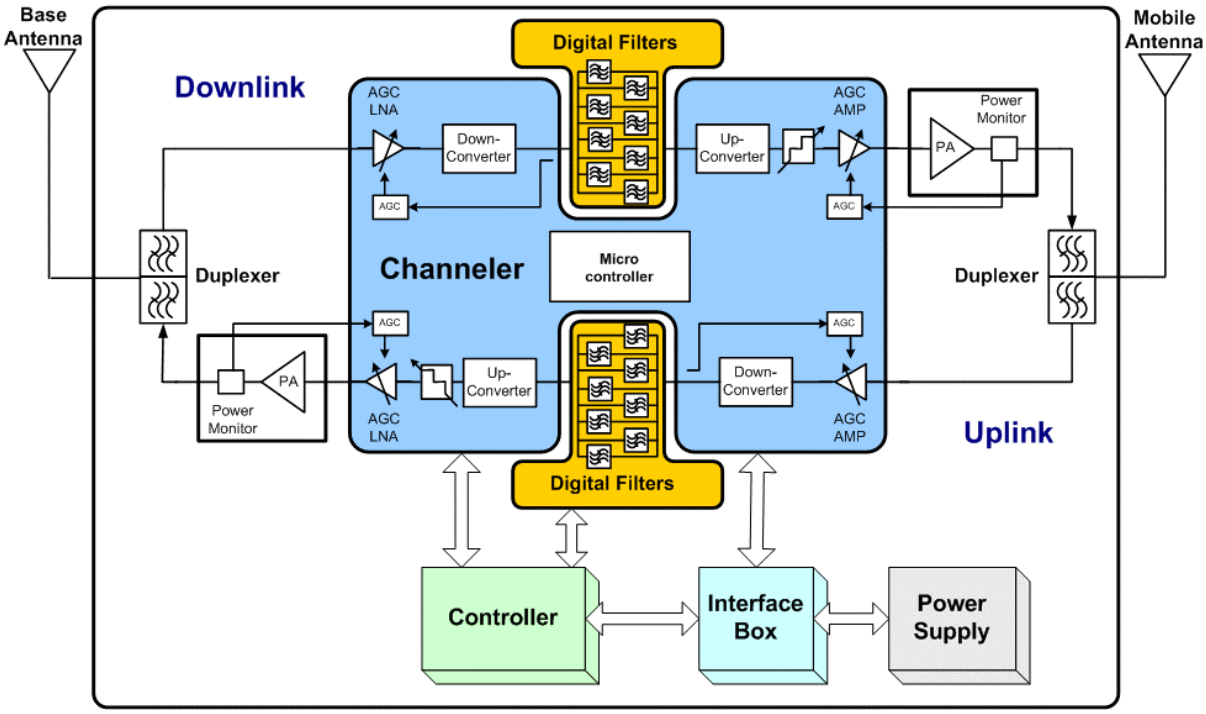

Figure 1: Digital Repeater - Block Diagram

The incoming RF signal from either the Base antenna (from the BTS) or from the Mobile antenna (from the mobile handset) enters the Repeater and is first filtered by the Duplexer. The incoming signal is amplified by an Automatic Gain Control (AGC) amplifier, then down-converted.

The input RF signal is then sampled and converted into a digital signal. This digital signal is filtered using fast parallel logic. The Repeater generates up to eight separate, programmable, and independent filters using digital processing techniques. These programmable filters sort the digital signal.

After filtration, the digital signals are converted back into analog signals and up-converted to RF signals by the Up-Converter.

The output RF signal is then amplified by a High Power Amplifier, and combined by a duplexer before output.

The output signal is emitted by the antennas, either towards the BTS in case of a signal from the mobile handset, or to the Outdoor antenna or to the Indoor antennas array, in accordance with the application.

3. DESCRIPTION

3.1 MAIN COMPONENTS LOCATION

Figure 2 provides the location of the main components of the Repeater. A list identifying these components is provided below.

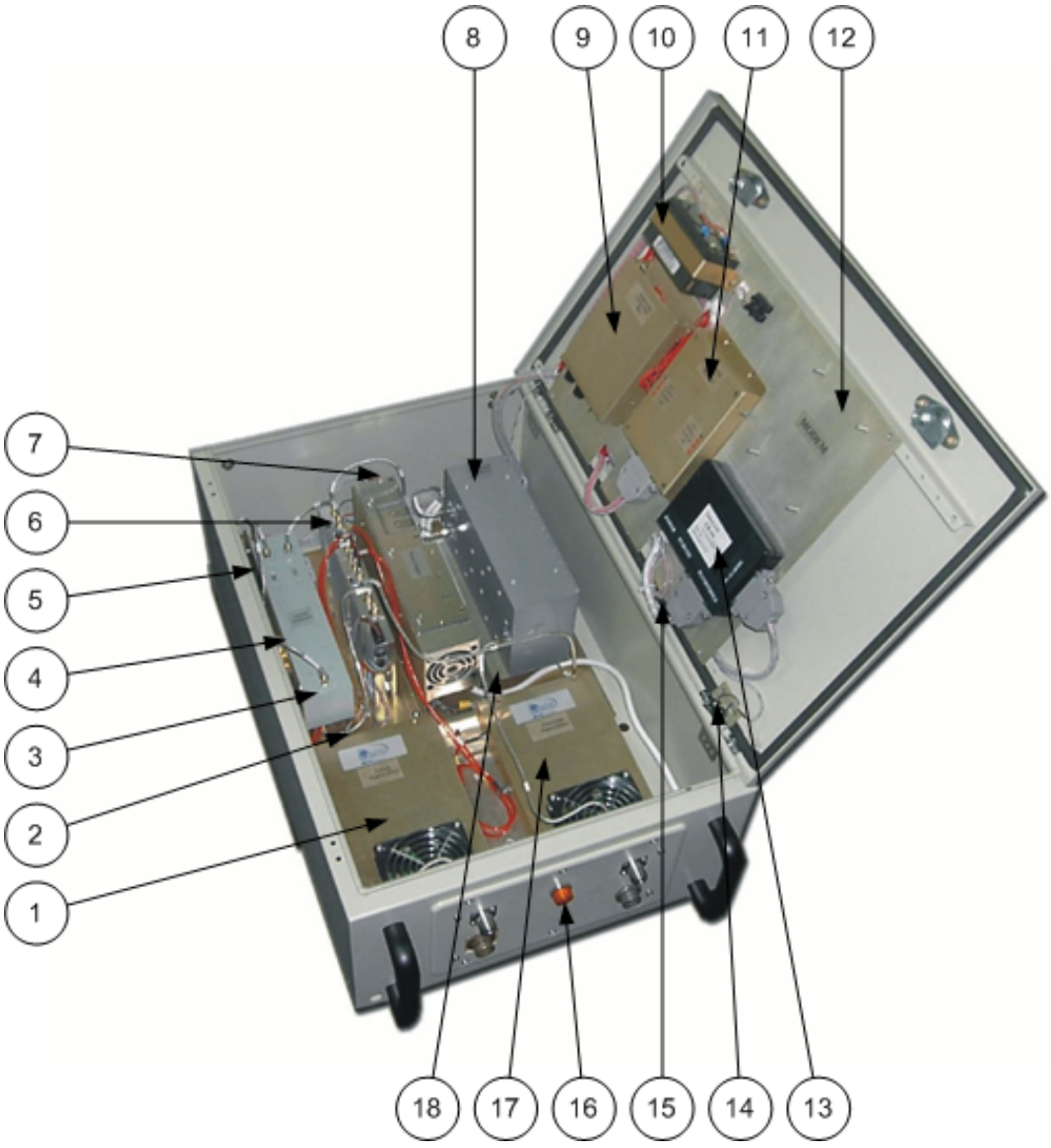

Figure 2: Digital Repeater - Main Components

A list of the Digital Repeater main units, in accordance with Figure 2, is provided below.

1. Digital Filter Module for the Uplink path (includes status LED)
2. Uplink Power Amplifier
3. Duplexer to Base Antenna (low power)
4. Coupler for Modem Antenna
5. Isolator for Uplink Amplifier
6. Channeler (Dual Up/Down Converter for Uplink and Downlink Paths)
7. Power Supply
8. Duplexer to Mobile Antenna (high power)
9. Connections Box (includes Repeater On/Off switch)
10. Controller Backup Battery Option
11. Monitor Module (includes alarm LEDs and a LEDs test pushbutton)
12. Wireless/wireline iDEN Modem Unit – Location
13. Controller (Control Box - CB) (includes a status LED)
14. Door Alarm Switch
15. Door plate
16. Digital Filter Module for the Downlink path (includes status LED)
17. External Power indication
18. Downlink Power Amplifier

3.2 COMPONENTS GENERAL DESCRIPTION

A description of the main components of the Digital Repeater follows.

3.2.1 Channeler

The Channeler Module consists of the dual Radio Frequency (RF) Up/Down Converter sub-modules for Downlink and Uplink paths.

The Channeler amplifies the input RF signals and converts them into an intermediate frequency (IF). The IF outputs of the Channeler are routed to the Dekolink Digital Filter (DDF) modules.

In the DDF, the IF inputs from the Channeler are converted back to their original frequencies. The Channeler also includes digital controllable attenuators (range 32 dB, in steps of 1 dB) and a pre-amplifier for each path.

3.2.2 Monitor Module

The Monitor Module monitors the Repeater operation and provides a visual warning whenever it detects a failed module or function. The monitoring is performed by measuring the current of several elements:

- DDF Uplink and Downlink,
- Up/Down Converter,
- Uplink Power Amplifier, and
- Power Supply.

If a module fails, the appropriate red LED lights up and a report is forwarded to the Control Box.

For a more detailed description of the module, refer to paragraph 3.3.

3.2.3 Controller

The Controller (also called Control Box) controls and monitors the parameters in all modules of the Repeater. It provides local or remote connection to a PC (See Dekolink's RMT User's Guide for more information.).

For a more detailed description of the module, refer to paragraph 3.3.

3.2.4 Digital Filter Module

Dekolink's Digital Filter Module uses digital processing techniques to generate up to eight separate, programmable, and independent filters. These filters are activated in both the Downlink and the Uplink paths.

The filter parameters can be modified and tailored to meet the customer's specific applications requirements.

3.2.5 Connections Box

The Connections Box module interconnects the Repeater Modules. This box includes the Repeater ON/OFF switch and the power fuses.

3.2.6 Power Supply

The Power Supply module allows a wide range of input power from different sources: 90 to 260 VAC, maximum power consumption - 350W.

The output power provided to the Repeater internal modules is:
28 VDC or 9 VDC.

3.2.7 Duplexers

The duplexers isolate the transmit path from the receive path. The pass bandwidth of the duplexer is the entire width of the Uplink band and the Downlink bands respectively.

3.2.8 Power Amplifier

The power amplifier is the final stage of both the Downlink and Uplink paths. The Digital Repeater includes Power Amplifiers with relatively high Third Order Intercept Point (IP3) figures, thus allowing high output power while preserving high linearity of the output signals.

3.3 MONITOR MODULE AND CONTROLLER DESCRIPTION

3.3.1 Monitor Module

The Monitor Module monitors the Repeater operation. It provides local feedback on some Repeater main modules operation. It issues a visual warning status through the LEDs on its top enclosure whenever it detects a failed module or function.

This module monitors the DC power supply by performing DC Current and Voltage measurements. The monitoring is performed by measuring the current of several elements:

- DDF Uplink and Downlink,
- Up/Down Converter,
- Uplink Power Amplifier

If a monitored element fails, the appropriate red LED lights up. The Monitor Module transmits the alarm status to the Control Box Module, which controls the Digital Repeater functions and detects operating failures.

Note

For a detailed description of the LEDs and the error messages, refer to Appendix B – Alarms.

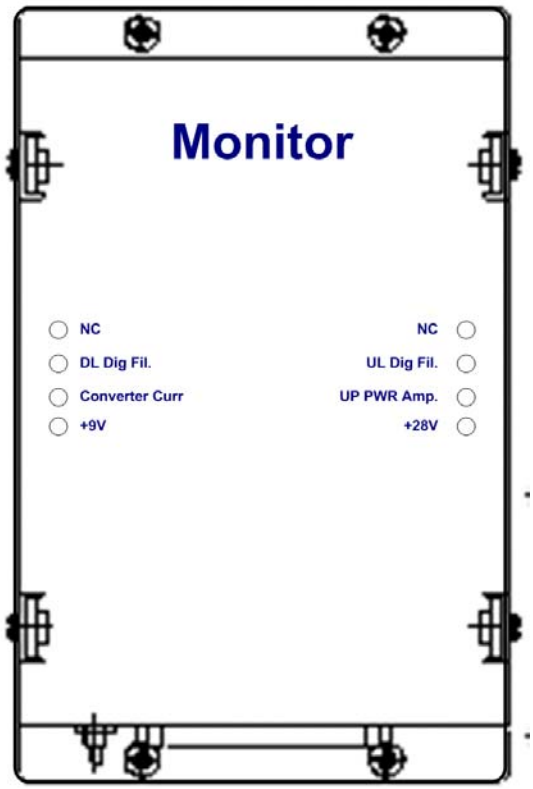

Figure 3: Monitor Module – Front Panel

3.3.2 Controller

The integrated Controller Module (Control Box) enables to set all the Digital Repeater parameters. This module controls the active components in the Repeater as well as monitors key operating functions. It communicates with two Dekolink Digital Filter (DDF) modules (Uplink and Downlink) via the serial port communication.

This Module controls the following functions:

- RF Gain,
- Power On/Off,
- AGC On/Off
- SALC On/Off

Two modes of monitoring and control are available:

- External PC - through the serial interface connector in the Control Box.
- Remote control - via a modem connected to the Control Box serial interface. A standard or cellular modem can be installed inside the Repeater enclosure, refer to Appendix D.

The Controller also sets the Dekolink digital filter parameters for each Dekolink Digital Filter (DDF) modules (Uplink and Downlink). This Module sets the Center Frequency, Bandwidth, slopes and Enable/Disable for each of the eight filters. It allows the independent shaping of the filters by selecting the required filter from a choice list of frequently used, factory provided filters. The Controller communicates with the two DDF modules (Uplink and Downlink) via its serial communication port.

Note

If additional unlisted filters are required, please contact your Dekolink representative.

The Repeater's parameters, including the filter settings, are defined and downloaded with the Dekolink's RMT software. For more information, see the RMT User's Guide.

This Module also provides Alarm Reports to the Digital Repeater's outside world.

The Controller transmits in two modes: Polling and Burst. When operating in Burst Alarm mode, the Controller generates a burst alarm and reports the faults to the local or remote connection. The Controller software handles the alarm reporting and parameters transmission to the Repeater's outside world.

3.4 SPECIFICATIONS

3.4.1 Electrical Specifications

This paragraph provides the electrical, mechanical and environmental specifications of the Digital Repeater.

Note

Specifications are subject to change without notice.

3.4.2 Electrical Specifications

Parameters	Downlink	Uplink
Frequency Range	Refer to paragraph 1.4..	
Pass band Gain @Min attenuation	90 dB typical	90 dB typical
Filters Bandwidth	12.5 –250 KHz (Programmable)	12.5 –250 KHz (Programmable)
Delay	20-80 µsec. Depending on filter Bandwidth and required slope	20-80 µsec. Depends on filter bandwidth and required slope.
Channel Ripple	± 0.5 dB max	± 0.5 dB max
Delay Variation	± 300 nSec max	± 300 nSec max
Noise Figure @max gain	6.0 dB	6.0 dB
Gain Control setting (by RMT software) user defined	30 dB @1 dB/step	30 dB @1 dB/step
3rd Order Output Intercept Point	+62 dBm typical	+50 dBm typical
IMD @ 4 tone	48 dBc typical @ 33dbm/tone	48 dBc typical @ 23 dbm/tone
Power Output @1 dB Gain Compression	50 Watt	10 Watt
Composite Output Power	+40 dBm	+30 dBm
Automatic Gain Control (user enable)	15 dB Attenuation Range	15 dB Attenuation Range
Impedance Level	50 ohms	50 ohms
V.S.W.R In/Out	1.5: 1 max	1.5: 1 max
Spurious Outputs	-13 dBm	-20 dBm
Power Supply	90 to 260 VAC, maximum consumig power350W	

3.4.3 Mechanical Specifications

The following table provides the mechanical specifications of the Digital Repeater.

Element	Value
Size H x W x D	600 x 400 x 300 mm (23.6 x 16 x 12 inch)
Weight	Approximately 42 kg. (92.4 lbs.)

3.4.4 Connectors

The Repeater interfaces with a Base antenna port and a Mobile antenna port. It includes four external connectors in its bottom panel, as described below.

Connector	Type
RF Connectors: BASE / MOBILE	N-type, Female
AC	Circular, 3-pin
Alarms	Circular, 8-pin

3.4.5 Environmental Specifications

Dekolink's Digital Repeaters meet the European IP65 and American NEMA4 weatherproof standards. The Repeater is designed to operate properly under the following environmental conditions.

Condition	Value
Operating temperature	- 30° C to + 50°C
Storage temperature	- 50° C to + 80°C

4. INSTALLATION

4.1 SAFETY INSTRUCTIONS

Before installing the repeater, review the following safety information:

- Follow all local safety regulations when installing the repeaters.
- Only qualified personnel are authorized to install and maintain the repeater.

When operating the repeater, it is recommended to keep its cover closed while the power is on. Some maintenance tasks may require the repeater door to be opened while the power is on. In such cases, perform the required tasks carefully and remember to close the repeater cover/door when finished.

- Ground the repeater with the grounding bolt located on the outside of the cabinet.
- Do not use the grounding bolt to connect external devices.
- Use a suitable mounting surface, such as a rigid wall.
- Follow Electro-Static Discharge (ESD) precautions.
- Before closing the repeater cover, make sure no wires are in the way.
- Install the repeater close to the service area to maintain the output power and noise figure.
- Use low loss cables to connect the antennas to the repeater.
- Install the repeater in a shielded, ventilated, and easy-to-reach area.

4.2 MECHANICAL INSTALLATION

The detailed mechanical instructions for the Digital Repeater are provided in the following publication:

Dekolink Digital Repeater – Deployment and Installation Manual.

Please refer to this document.

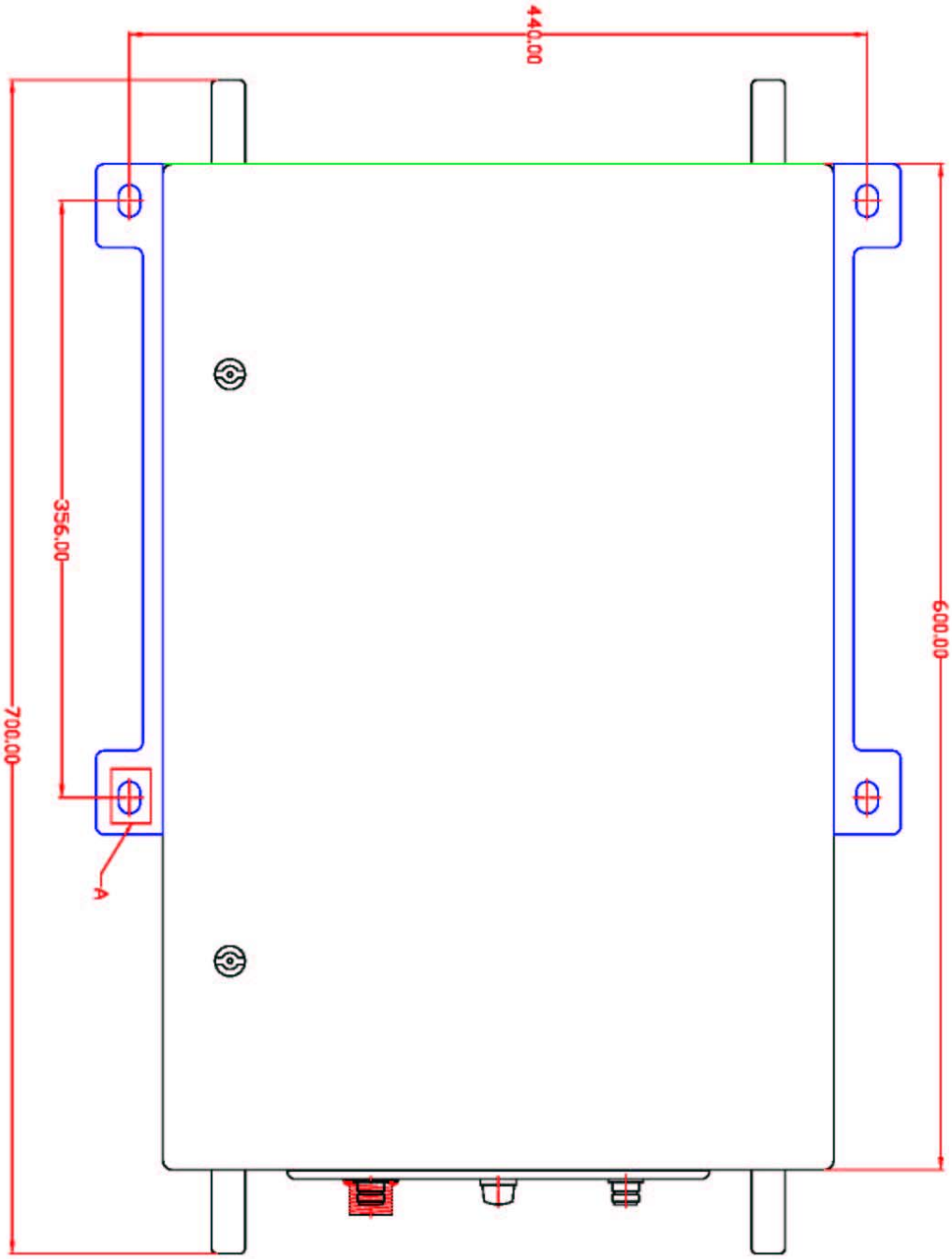

Figure 4: Digital Repeater - Dimensions

4.3 CONNECTIONS

4.3.1 RF Connections

The connection ports are located in the bottom panel of the Digital Repeater. The RF connection to the Digital Repeater is made via two N-Type female connectors.

The RF connector labeled "BASE" must be connected to the antenna pointing to the base station (Donor antenna), which is usually a rooftop antenna, Yagi type or dish..

The RF connection labeled "MOBILE" must be connected to the antenna pointing to the area covered by the Repeater (Service antenna) such as inside a building or in an outdoor, RF shaded area.

Note

Do not operate the repeater without terminating the antenna connections with actual antennas or proper dummy loads.

4.3.2 Connections – Power Requirements

The repeater operates from a power source of 110V/220 VAC. The maximum consumption power is 350W.

- Connect the AC power cable to the AC connector in the Repeater.

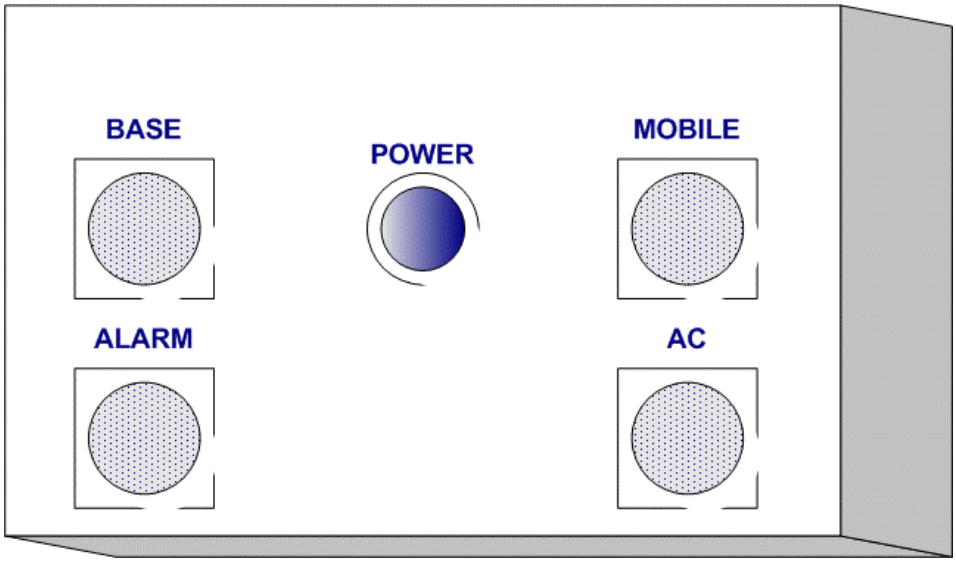

Figure 5: Monitor Module – Bottom Panel

4.4 RF EXPOSURE WARNING

4.4.1 General

In order to satisfy the FCC RF exposure requirements, it must be ensured that the installation complies with the following requirements.

4.4.2 Donor Antenna requirements

The Donor antenna connected to the BASE port in the Repeater is usually installed outdoor. This antenna has a very sharp beam (Yagi type or similar) pointed to the BTS This type of antenna has 12-20 dBi gain. Cable and jumper loss is at least 2dB.

The Donor antenna must be installed to provide a minimum separation distance of 1 m from any personnel within the area.

4.4.3 Mobile Antenna requirements

The second antenna is connected to the MOBILE port in the Repeater. This interface serves either an Outdoor antenna or an Indoor antennas array, in accordance with the application.

In case of Outdoor application, the antenna type is omnidirectional (isotropic) with 0 to 2 dBi typical gain, or wide beam with up to 10 dBi gain. This antenna is installed on a mast to cover a shadowed outdoor area. Cable and jumper loss is at least 2dB. Installation of this antenna must provide a minimum separation distance of 1 m from any personnel within the area.

In case of Indoor coverage, the output power is split into several, omni directional antenna with 0 to 2 dBi typical gain, and distributed to different indoor areas (in building floors, tunnels, basements, parking lots, shopping centers etc.). At least 5 such antennas must be connected to the Repeater with cables and splitters. In this application, the maximum EIRP from each antenna shall not exceed 3W. Consequently, the minimum required separation distance from any personnel within the area is 20 cm. Less separation is needed if the power is divided into more than 5 antennas covering many floors or areas.

5. REPEATER MANAGEMENT TOOL (RMT)

5.1 GENERAL

The Repeater Management Tool (RMT) software supplied with the Digital Repeater provides full access to all control settings and monitoring capabilities. The RMT software can be installed on Windows 95, Windows 98, Windows 2000, and Windows XP operating systems.

RMT is used to manage, monitor and control the repeater locally via a serial connection or remotely through a modem. See the RMT User's Guide for more information.

The RMT allows either a local or remote connection for control of the Repeater.

5.2 LOCAL CONNECTION

To set up a local connection:

- Turn on the Repeater and wait for the power LED on the Control Box in the Digital Repeater to begin flashing rapidly.
- Connect an external serial cable from an external PC (COM interface) to the Control Box.
- Set the Baud rate to 57,600 bps with the RMT software program. (Refer to the RMT User's Guide for more information.)

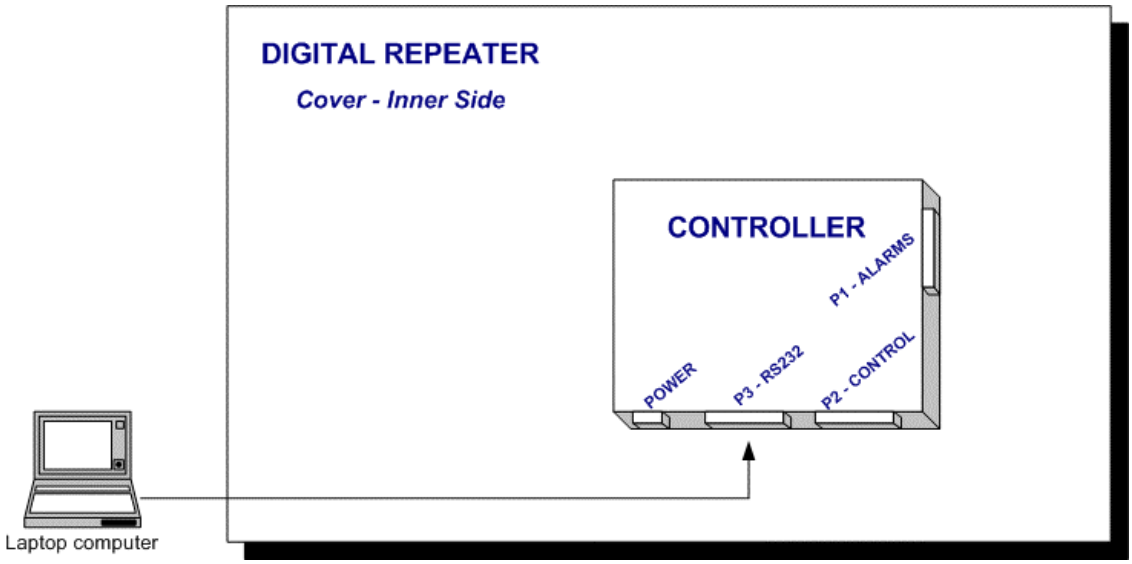

Figure 6: Digital Repeater - Local Monitoring with Laptop

5.3 REMOTE CONNECTION

To set up a remote connection:

Note

The remote connection is performed to a PC.

1. Connect a modem to the PC serial COM port
2. Set the Baud rate to 57,600 bps with the RMT software (Refer to the RMT User's Guide for more information.)

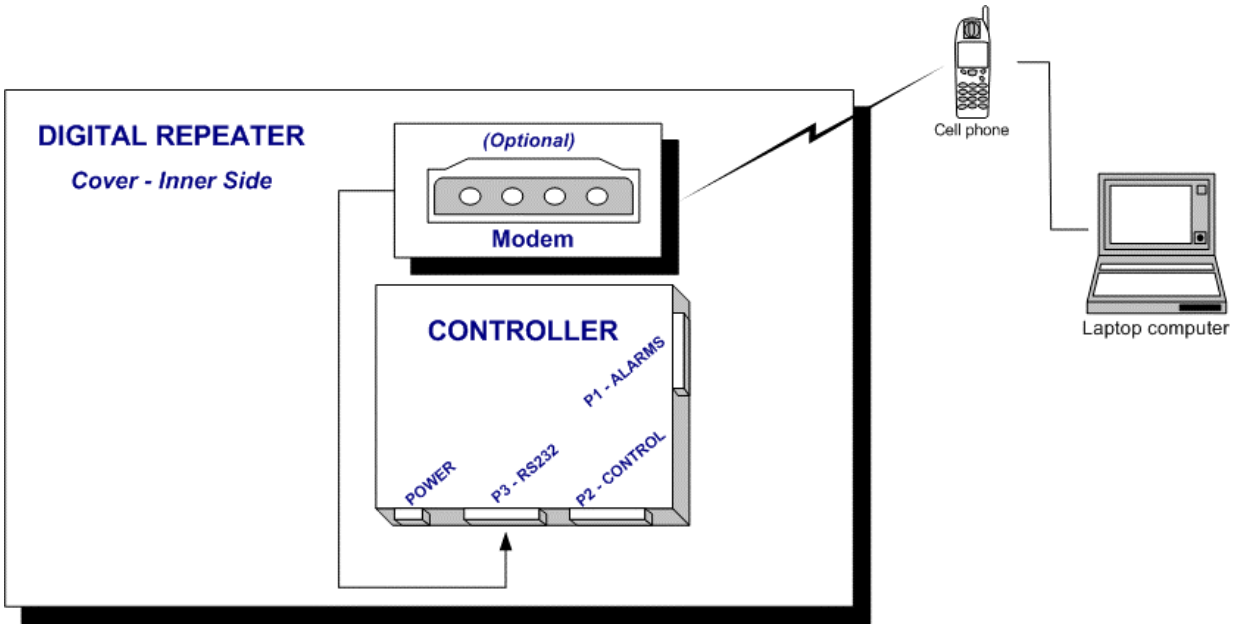

Figure 7: Digital Repeater - Remote Monitoring and Control Connection Diagram

See Appendix D: Modem Installation for further installation procedures.

6. OPERATION

6.1 GENERAL

Carry out the following steps to operate the repeater (Refer to the RMT User's Guide for additional information.)

6.1.1 Initial Setup

Perform the following procedures (if not yet performed):

Note

The following are further described in the Deployment and Installation Manual.

- Measure the isolation between the antennas
- Measure the power of the chosen channels in the donor antenna field (Use external test equipment for this action.)
- Install the unit in the field
- Connect the antenna cables to the Repeater's BASE and MOBILE connectors
- Connect the AC power cable to the AC connector

Note

After the AC power is connected to the repeater, the Power Supply, and the fans start operating in the Repeater. Please note that the Repeater does not start operating until the ON/OFF switch located on the Connections Box is set to ON).

- Turn on the Repeater (The ON/OFF switch is located on the Connections Box).
- Connect a PC/laptop to the Repeater's Controller with a serial cable for local connection (Refer to the RMT User's Guide for details).
- For Remote connection instructions, please refer to Appendix D.

6.1.2 RMT Software – Setting Procedures

Using the RMT software, perform the following procedures:

- Mute the downlink and uplink amplifiers so that they do not interfere with the frequency spectrum.
- Set the maximum transmitted power for Downlink and Uplink(Max Power) according to the actual onsite requirements
- Set the Max Gain according to the measured/calculated input power. Dekolink recommends setting the Maximum Gain value to approximately 18 dB less than the isolation between the antennas/
  If you use SALC, there is no need to measure or calculate the gain in accordance with the required output power because it is adjusted automatically to attain the selected power. (For more information, see section 9.4, Smart-ALC Function).

- Click the **Digital Filters Application** button in the Repeater Interface screen
- Select **Tools** / **Read Filters** in the Menu bar
- Click **Yes** in the dialog box. The current digital filter configuration in the Repeater is displayed
- Set the filter configuration (number of filters, frequencies and filters type) in the **Downlink** page
- Activate the relevant channels by clicking √ in the **On/Off** checkbox
- Select the **Uplink** tab and set the digital filter configuration accordingly.

After defining the digital filters (Downlink and Uplink), download the new data to the repeater so that the information can go into effect.

6.1.3 Saving the Settings

Two ways to save the settings into the repeater are available:

- Download to RAM for temporary setting, and
- Burn-in to Flash for permanent setting.

To savethe settings:

- Click **Download to RAM**.
  This technique is recommended for trials, tests and preliminary setup of the digital repeater until the final configuration of the digital filters is achieved. You can download the settings an unlimited number of times using **Download to RAM**.
  This process is however volatile and the information will be lost in the event of a power failure. The DDF parameters are kept in a volatile memory only, and should be burned to a Flash memory at finalization of the process.
- Click the **Burn-in to Flash** button to download the data to a non-volatile (FLASH) memory.
  You can download the data to the Flash memory a relatively large but limited number of times (several hundreds). It is recommended to burn the data into the Flash memory only, after you are satisfied with the filter settings for the required application and intend to use it for long period of time.

To finalize the procedure:

- Disable the **Mute** for the downlink and uplink amplifier and test the performance in the coverage area. (**Mute** is the output power on/off control, which can be set via "**P.Amp On**" checkbox.)
- Save the configuration files of the digital filters by selecting **File** / **Save** configuration in the Digital Filter Application and assigning a appropriate name to the file. This data is not saved in the RMT Database.

6.2 SMART-ALC FUNCTION

6.2.1 SALC Description

The Smart Automatic Level Control (Smart-ALC) is an innovative solution for automatic repeater gain adjustment. Combined with advanced control algorithms, SALC can perform gradual learning of traffic load characteristics and adjust the Repeater Gain to the desired value.

This automatic operation practically removes the need to make initial settings for maximal traffic load conditions and eliminates the need for numerous site visits to take care of Gain adjustment.

SALC also reduces isolation problems and Sync amplification, and maintains Uplink/Downlink balance.

6.2.2 ALC Function

The Repeater includes the Automatic Level Control (ALC) function on both the Uplink and Downlink power amplifiers to prevent the saturation of the amplifier.

The amplifier includes a directional coupler and a detector that monitor the output power. The ALC mechanism samples the output power, and decouples and rectifies it. The ALC mechanism sends a feedback signal to a voltage variable attenuator (VVA) that, whenever a high input signal is received, attenuates the signal level so that the output power of the amplifier does not exceed the preset limit.

This level control ensures that the power amplifier operation stays within the linear region only, thus preventing saturation and signal distortion.

The ALC protects the amplifiers from overloading and prevents the system from generating spurious emissions. ALC limits the output power to a constant value (Maximum output power). The ALC is factory preset to ON state.

6.2.3 RF Gain Setting

The gain range is 59-90 dB. The RF Gain is set separately for Uplink and Downlink.

The gain range should be set via the RMT in accordance with the input signal power at the Donor antenna, and in accordance with the required Downlink output power. The gain range is set using the Max Gain function (beware not to exceed isolation limits, see note below).

The Uplink Gain is set by the Gain Delta field (that is the difference between the Downlink Gain and the Uplink Gain) in accordance with the system needs. Note that usually this field is set to “0” for system transparency. Please refer to Installation Manual.

Note

It is recommended to set the Downlink path gain to a maximum of 18 dB below the isolation between the Base antenna and the Mobile antenna.

7. MAINTENANCE AND TROUBLESHOOTING

7.1 GENERAL

This section provides the maintenance and troubleshooting procedures for the Digital Repeater.

7.2 PERIODIC MAINTENANCE

There is no periodic maintenance required for the Digital Repeater. As long as it is installed in a shaded area and not subject to extreme temperatures, it will provide long term, carefree operation.

7.3 VISUAL INSPECTION

Note

Refer to Appendix b – Alarms and LEDs.

Check the following normal LEDs status inside the repeater:

- During normal operation, all LEDs are off.
- The LEDs should be checked 10 seconds after setting the Repeater on. Their status should be as described below.

7.3.1 Monitor Module

All LEDs in this module are off.

These LEDs indicate faults in the Repeater and the status of some of them is also displayed in the RMT main screen.

7.3.2 Controller Module

Ten seconds after turning the Repeater on, the Controller LED starts blinking rapidly. This is a normal state and indicates that you can now make a connection to the Controller via its RS232 port, and set the list of filters as defined by the RMT software.

7.3.3 Digital Filters Modules

The LEDs located on these modules indicate the power status.

7.4 ALARMS

The Repeater issues a series of alarms to warn for malfunctions, as listed in Appendix B.

7.5 TROUBLESHOOTING

The following table summarizes various error/warning alarms and indications, their possible cause, and a course of action to correct the problem.

Indication	Probable Cause	Recommended Action
Power Supply Voltage alarm	Supply voltage fault	Check if the temperature alarm is active. If so, see temperature alarm below. Turn the power off and on again (*).
Power Amplifier Uplink Current alarm	Power Amplifier Fault	Mute the Uplink Power amplifier. Turn it back on (*).
Channeler Current alarm	Channeler failed	Check if a temperature alarm is active. If so, see the Temperature alarm below. Check if the Lock Detect alarm is active. If so, see the Lock Detect alarm below. Decrease the gain of the Repeater to minimum, check the alarm, and turn it back to Maximum Gain (*).
Downlink/Uplink Digital Filter module's current alarm	High/Low current fault in the Downlink/Uplink Digital Filter modules and in the fan	Reset the Digital Filter by pressing the Reset button. Change the number of channels that are active to minimum and then turn it back to maximum (*).
Downlink/Uplink Communication alarm	The communication between the Controller and Downlink/ Uplink Digital Filter failed	Reset the Digital Filter unit by pressing the Reset button. Reboot the repeater (*).
Downlink/Uplink Lock Detect alarm	Faulty status of the Phased Locked Loop (PLL) in the Channeler unit	Reboot the Repeater. Check the connection between the Controller and the Channeler (*).
FWD Power Amplifier alarm (this is not a fault)	Composite output power is below the threshold value	Check the Donor antenna connection. Check that the Donor antenna alignment is in line of sight with the Base station.

Indication	Probable Cause	Recommended Action
		Increase the RF Gain. Verify the filters' frequency setting.
Downlink Return Power [VSWR] alarm	High Voltage Standing Wave Ratio (VSWR) at the Mobile port	Check the antenna and cable connection at the Mobile port. Replace the antenna if necessary.
Temperature alarm	Indicates an inner temperature over 60ºC. The power supply shutdowns the Repeater when the temperature reaches 70ºC	Verify that the repeater is mounted correctly, with the Repeater gland plate facing the floor. Increase ventilation.
Door Open alarm	Indicates that the Repeater door is open	Close the Repeater door. Check the connection of the door switch.
Excessive inter-modulation or spurious frequencies alarm (External test equipment)	Amplifier oscillation caused by insufficient isolation	Improve the isolation between the antennas or reduce the RF gain. Use the Smart ALC feature.
Excessive noise in Downlink /Uplink	High input power causing amplifier overload	Use the Smart-ALC feature Reduce the Max Gain in the Downlink path Check the input power to the repeater - should be less than 20 dBm Check the Channeler LEDs. If active (red), this indicates that the input power to the repeater is high If the signal in the donor side is too high, connect an external 10dB attenuator in series to the Base connector and increase the gain by 10dB.
Connection to the Controller failed in the local connection	Communication failure	Check the physical connection between the PC COM1 and the Controller RS232 interface. Verify that the LED of the controller is blinking rapidly.

Indication	Probable Cause	Recommended Action
		Reboot the Repeater. Restart the PC. Re-install the Controller software *
Connection with the Repeater failed in the remote connection	Communication failure	Check that the modem is physically connected to the controller serial input. Verify that the modem local port baud rate is 57,600 bps. Verify that the Controller LED is blinking. Verify that the modem is connected to the antenna cable via the RF coupler. Restart the PC. Reinstall the Controller software.

(*) If the indication remains after the On/Off procedure, replace the Repeater.

APPENDIX A: MECHANICAL OUTLINE

This appendix contains the mechanical outline of the Repeater.

Digital Repeater - Mechanical Outline

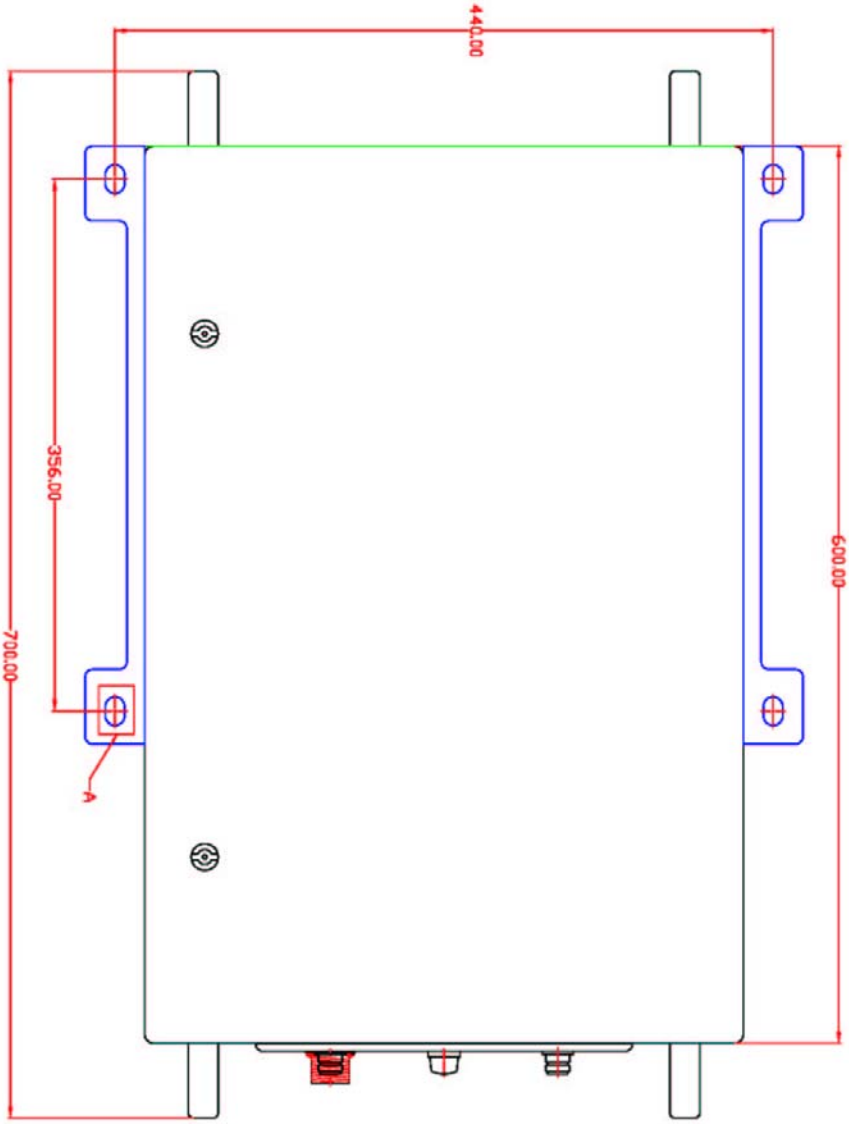

Figure 8: Digital Repeater – Mechanical Outline

Digital Repeater - Case Outline

The following figure shows the Case layout for Repeater Model Number: MW-DBDA-SMR-50W85

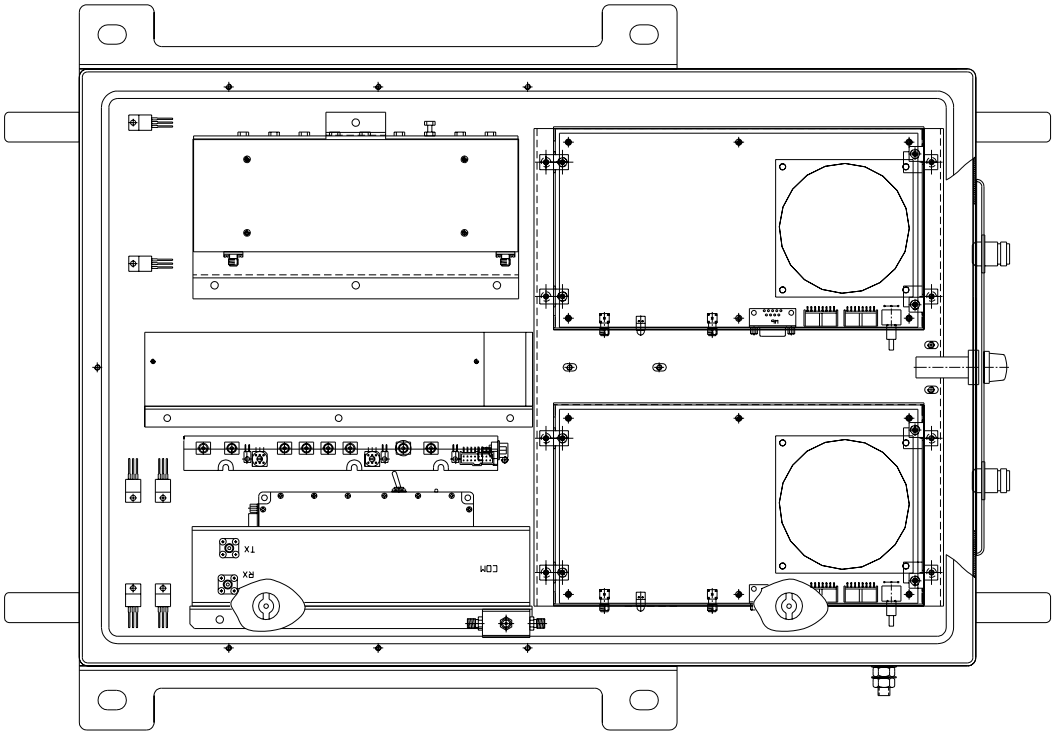

Figure 9: Digital Repeater – Case Layout

The following figure shows the Case layout for Repeater Model Number: MW-DBDA-SMR-50W90-PS9

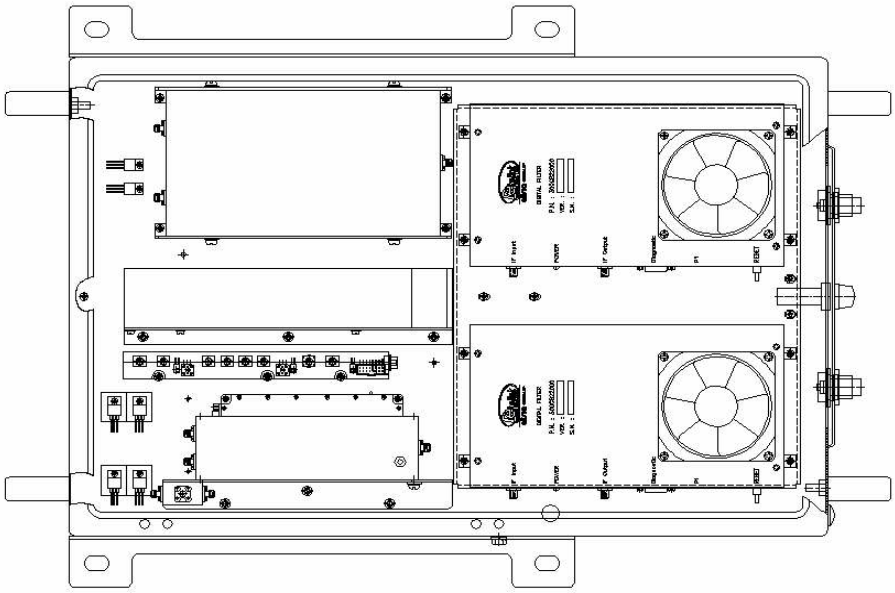

Figure 10: Digital Repeater - Case Outline

Digital Repeater - Cover Outline

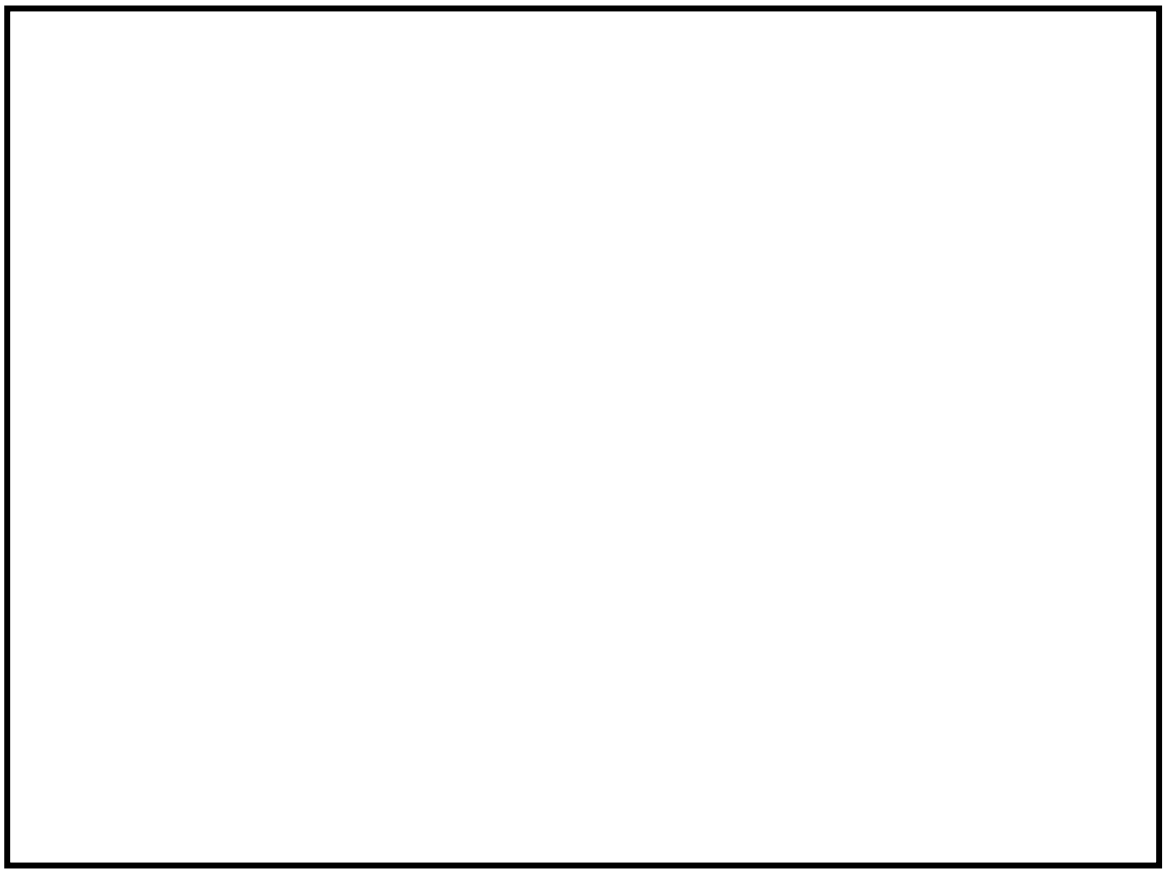

Figure 11: Digital Repeater - Cover Outline

APPENDIX B: ALARMS AND LEDS

General Alarms

In case of failure, the repeater triggers an alarm message and transmits its alarm status to the NMS through a remote or local PC connection In addition, the relevant LED lights up in the Repeater external front panel.

The major alarms issued by the Digital Repeater are described below. A description of the LEDs statuses is provided in following paragraphs.

Temperature Alarm

This alarm is triggered when the chassis temperature exceeds 60C° (ambient) within the Repeater case.

Main Voltage Alarm

This alarm is triggered when the Power Supply voltage is outside its limits. The operating voltage is 28V.

Monitor Module Alarms

General

The Monitor Module controls, by measuring the current, major functions of the Repeater, such as:

- DDF Uplink and Downlink,
- Up/Down Converter,
- Uplink Power Amplifier, and
- Power Supply voltage.

Some of these alarms trigger a red LED on the Repeater Monitor Module.

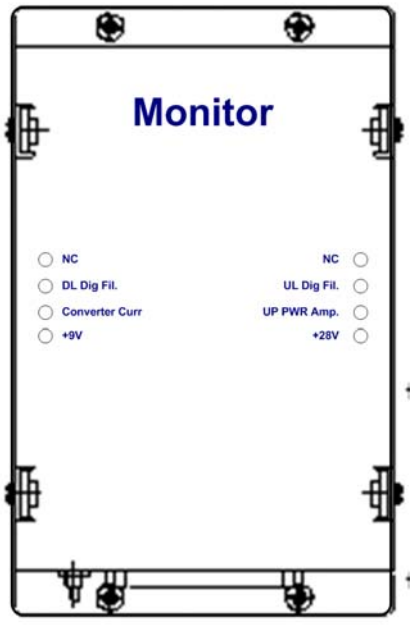

Figure 12: Monitor Module – LEDs Location

Uplink and Downlink Alarms

A list of Uplink and Downlink alarms is provided below.

Power Amplifier

Uplink Forward Power Amplifier Current Alarm: This alarm is triggered when the Power Amplifier current is outside of its specified limits.

Downlink Threshold Forward Output Power Alarm: This alarm is triggered when the Power Amplifier output is lower than the specified limits.

Channeler

This alarm is triggered when the Channeler current is outside of its specified limits.

Channeler Lock-Detect

This alarm is triggered when the Channeler synthesizers are unlocked.

DDF Current

This alarm is triggered when the DDF current (including the internal fan) is outside of the specified limits.

Voltage Standing Wave Ratio (VSWR)

This alarm is triggered when the return loss of the Downlink antenna or cable connection exceeds 6 dB (VSWR 3:1).

The VSWR module measures the voltage standing wave ratio of the Downlink output antenna port. If the VSWR falls below 13 dB, an alarm is triggered.

This alarm provides an indication of the status of the cable connected to the antenna. If a cable is defective, the VSWR is decreased and the alarm is triggered again. The alarm can be forwarded to the RMT so that faults and irregularities can be recognized and eliminated rapidly.

DDF Communication

DDF communication is triggered when the Repeater Controller fails to communicate with the DDF unit. The communication with digital repeater components is made via the Control Box. If the Controller fails to read/update parameters with the Digital Filter module, it triggers the communication alarms.

Measurements

Temperature Measurements: Measures ambient temperature of the digital repeater chassis. A temperature sensor is placed on the heat sink and provides analog voltage to the Control Box. The controller processes the input with a formula and provides the measured temperature.

Downlink Forward Power Measurements: Measures the output power of the Downlink (if the output power is less than 30 dBm, 30 dBm is displayed.) This module measures the composite output power in the downlink output path of the repeater.

Output Power Alarms

If the output power falls below a certain level, an alarm is triggered. You can set the power level and the mask for the alarm. (See the RMT User's Guide for more information.) This feature provides you with the output power of the repeater and thereby achieves optimum output power.

The alarms can be forwarded to the RMT by burst or polling, so that faults can be recognized and eliminated rapidly.

Alarms Summary Table

The following table lists the alarms.

Alarm	Alarm Description
Door Open	Generates an alarm when the Repeater door is open.
Temperature	Generates an alarm when the ambient temperature is above 60º C inside the Repeater enclosure.
Power Supply 9V or 28V (triggers a LED)	Generates an alarm when the power supply exceeds the designated limits (±2V).
Fan Failure	Generates an alarm when the fan current is outside of the allowed limits.
External Alarm	Generates an alarm when the external input contacts are open or closed (User Definable).
Lock Detect Alarm	Generates an alarm when the Channeler Reference frequency is not stable.
Channeler Current (triggers a LED)	Generates an alarm when the Channeler current is outside of the allowed limits.
Downlink VSWR Alarm	Generates an alarm when the Downlink VSWR is above 1:2.5
Downlink Forward Power Alarm	Generates an alarm when the Downlink power is less than the Power Threshold value (User definable)
Digital Filter Current Alarm	Generates an alarm when the digital filter module current is outside of the allowed limits.
Digital Filter Communication Alarm	Generates an alarm when communication with the DDF unit fails.

External Alarms Connector Pinout Definition

The following table details the pinout definition of the External Connector located in the gland plate of the repeater.

Letter	Description	Color Code
A	External Switch No.2	Green/White
B	Ground	Black
C	Not Connected	N/A
D	N/A	N/A
E	Alarm Out from Monitor Unit (shortened to the DC connector pin)	Black/White
F	Alarm In from Monitor Unit (shortened to DC connector pin)	Black/White
G	External Switch No.1	Gray
H	Ground	Black
A	External Switch No.2	Green/White

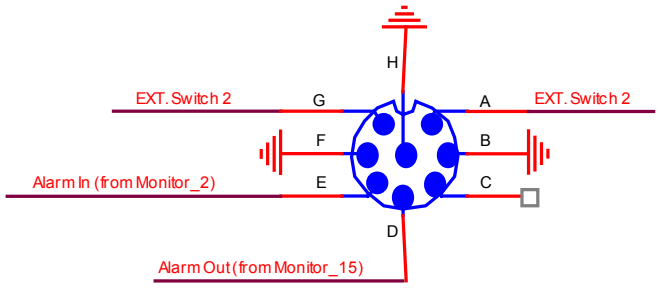

Figure 13: External Alarms Connector – Pinout

Notes

1. Use Gray and Black Wires for External Alarm 1 (Open/Close according to the connected device).
2. Use Green/White and Black Wires for External Alarm 2 (Open/Close according to the connected device).

LEDs

General

If any of the Repeater major functions as listed below fails, the relevant LED lights up in the Monitor Module panel (see Figure 12):

- DDF Uplink and Downlink,
- Up/Down Converter,
- Uplink Power Amplifier, and
- Power Supply voltage.

In addition to the LEDs, the alarm indication is sent to the Control Box that triggers an alarm message. This allows receiving the alarm status of the Repeater from the Monitor Module with a remote or local PC connection.

LEDs Description / Cause of Failure

The following table lists the probable cause of failure in accordance with the LEDs statuses.

LED	Description / Probable Cause of Failure
NC	Not in use (not connected)
DL Dig Fil.	Downlink digital filter failed
Converter Curr	Channeler current failed
+9V	Power supply (+9V) failed
NC	Not in use (not connected)
UL Dig Fil.	Uplink digital filter failed
UP PWR Amp.	Uplink power amplifier failed
+28V	Power supply (+28V) failed

APPENDIX C: INSTALLING THE REPEATER IN A LABORATORY SETTING

If you want to test the performance of the repeater prior to actually installing it in the field, you can do so in a laboratory setting as follows:

Note

In the event that the antennas are not connected, terminate the Base and Mobile connectors with a 30 dB attenuator or 50 Ohm load. This will prevent a regressing signal from damaging the test equipment.
Use 30db attenuators with a power rating of at least 50W at the Mobile connector and at least 10W at the Base connector.

- Connect a Power Supply voltage (90 to 260 VAC) to the Repeater's AC connector (refer to the test diagram below).
- Connect an RF Generator to the Repeater's Base connector
- Inject an RF Signal from the connected RF Generator to the downlink route through the Base connector.
- Connect a Spectrum Analyzer to the Mobile connector.
- Test the repeater's RF performance.

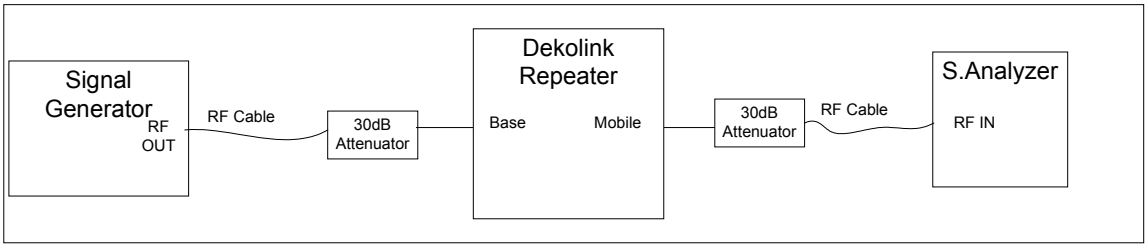

Figure 14: Repeater Downlink Route RF Performance Test Setup

- Test the Repeater's Uplink route by connecting the RF Signal Generator to the Mobile connector
- Connect a Spectrum Analyzer to the Base connector (refer to the test setup diagram below).

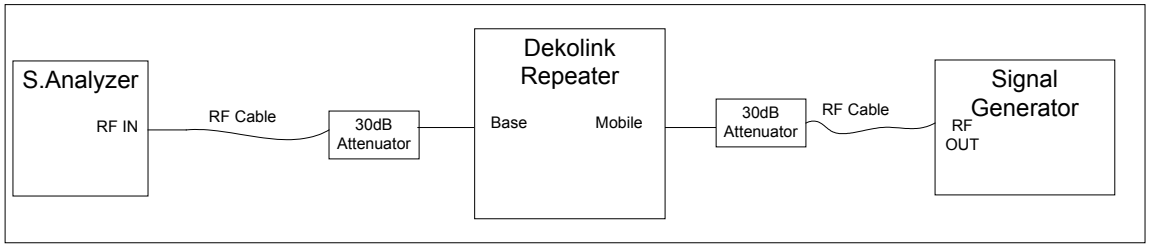

Figure 15: Repeater Uplink Route RF Performance Test Setup

APPENDIX D: MODEM INSTALLATION (OPTION)

General

The Digital Repeater is ready for connection of a serial, Hayes Compatible, AT Command type modem with a phone number to allow connection in a circuit switched network.

If you are using a modem with a SIM card, special settings (network or terminal definitions) may be needed to allow data transmission.

Modem Installation

Perform the following steps to install a standard modem:

- Connect the modem to the power supply.
- Install the modem with a straight serial cable. This cable is usually supplied with the modem. (See the tables below for the pinout description.)
- Use a PC with the same terminal mode and bit rate as the default modem baud rate. For example, 57,600, 19,200, 14,400 bps or other baud rate depending on the modem default configuration.

Use the following commands:

- AT S0=0 <ENTER>
- AT+IPR=57600 <ENTER>
- Change terminal baud rate to 57,600 bps if necessary.
- Use the PC in terminal mode to save the new baud rate settings.

Use the following commands:

- D AT&W1 <ENTER> (For some modems)
- AT&W0 <ENTER> (For other modems)
- Disconnect the serial cable from the PC and connect it to the Controller in the Repeater.
- Connect the antenna cable to the modem antenna port. (When testing the unit in a laboratory, connect the modem to an external antenna) Refer to Appendix C for more information.
- Connect the modem to a Power Supply unit terminal.
- Turn the Repeater AC power on.
- Use a PC with a wireless or Plain Old Telephone System (POTS) modem and the Dekolink RMT software to monitor the repeater.
- Refer to the RMT User's Guide for more information on how to establish remote connection with a repeater.

Connector Pin-out

Serial Cable Pin-out for Local Communication between the PC and the Controller:

PC Pinout	CB Pinout
2	3
3	2
5	5
D-Type 9 Pin female	D-Type 9 Pin female

Serial Cable Pinout for Remote Communication between the Modem and the Controller:

DCE Modem	DTE Controller
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
D-Type 9 Pin female	D-Type 9 Pin male

APPENDIX E: DEKOLINK WIRELESS LIMITED WARRANTY

Dekolink Wireless [Ltd.] ("Dekolink"), manufacturer of this product (the "Product") warrants to the original purchaser ("Purchaser") that the Product is free from defects in materials and workmanship for a term that ends on the earlier of twelve (12) months from the date of activation of the Product or fifteen (15) months from the date of shipment of the Product by Dekolink. The obligations of Dekolink under this warranty shall be limited solely to the repair or exchange or giving credit for, at the option of Dekolink, any Product that may prove defective in accordance with evidence satisfactory to Dekolink. Any repair or replacement of the Product by Dekolink shall not extend the original warranty period. This warranty is exclusive to the original Purchaser and is not assignable.

This warranty applies only upon the condition that the Product has been installed, maintained and operated under conditions of normal use. The provisions of this warranty shall not apply if, in Dekolink's judgment, the Product has been subject to misuse or neglect, damaged in an accident or by act of vandalism, or repaired or altered in any way that adversely affects its performance or reliability.

To obtain warranty service, Purchaser may, upon the prior written authorization of Dekolink or its authorized service representative, return the defective Product to Dekolink's authorized service center. All shipping and insurance charges are the sole responsibility of Purchaser and are not included in this warranty.

Dekolink expressly excludes and disclaims all other warranties, including but not limited to any warranties of merchantability or fitness for a particular purpose.

Dekolink shall in no event be liable for any special, indirect, incidental, consequential or punitive damages or for loss, damage, or expense, including loss of use, profits, revenue, or goodwill, directly or indirectly arising from purchaser's use or inability to use the merchandise, or for loss or destruction of other property or from any other cause, even if Dekolink has been advised of the possibility of such damage. Some states do not allow the exclusion or limitation of incidental or consequential damages so these limitations may not apply under certain circumstances.

The liability of Dekolink shall in no event exceed an amount equivalent to the purchase price paid by the purchaser for the defective product.

This warranty shall not be extended, altered or varied except by a written instrument duly signed by Dekolink.