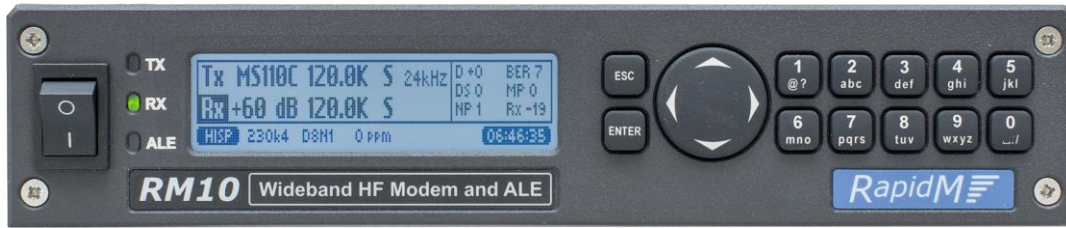




WBHF 24 kHz

ALE 4G, 3G & 2G

V/UHF 25 kHz



RM10 Product Overview

The RM10 Wideband HF Modem and ALE provides a purpose-built standalone hardware platform for strategic and maritime WBHF Beyond Line-of-Sight (BLOS) and V/UHF Line-of-Sight (LOS) radio communications.

The Wideband Automatic Link Establishment (WALE) or Fourth Generation (4G ALE) controller compliant with MIL-STD-188-141D Appendix G is used in setting up and managing WBHF links. The WALE controller provides fast and robust link setups by dynamically adapting the bandwidth and frequency offset of wideband channels to avoid interference and optimize throughput. The WALE link setup controller also provides inter-operation with second generation ALE (2G ALE) and third generation ALE (3G ALE/FLSU). WALE supports (as 3G ALE) both synchronous and asynchronous modes.

Key Features

- **Standard Compliance** – MIL-STD-188-141D App G (WALE)
- **WALE/4G ALE Link Setup:**
 - Adaptive – selects bandwidth, frequency offset and data rate based on observed channel conditions
 - Spectral Sensing to dynamically avoid interference
 - User Traffic Type is negotiated during link setup
 - Service oriented LSU using traffic type & min. data rate
 - Inter-operation with ALE 2G & ALE 3G controllers
- **WALE Protocol:**
 - WALE Address: 16-bit PDU and 16-bit Network number
 - Synchronous and asynchronous link setup
 - Point-to-Point, Point-to-Multipoint and Broadcast links
 - Automatic channel selection for calling channels.
 - Wideband traffic channel negotiation: 2-way, 3-way & override.
 - Orderwire messages - Text and Binary
 - Utility Protocols:
 - Late Net Entry,
 - Data Fill & Time-of-Day distribution
- **WALE Waveforms:**
 - Fast WALE waveform - very fast link setup
 - Deep WALE waveform – adverse channels
- **WALE Linking Protection** - HALFLOOP Algorithm, 128-bit key
- **Split-Site Operation** – ALE 2G, 3G & 4G (WALE) & Modem

Wideband ALE (WALE/4G) Controller

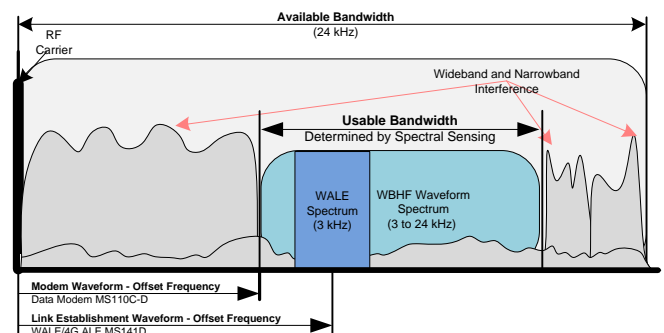
The RM10 provides an implementation of the Wideband Automatic Link Establishment (WALE) as per MIL-STD-188-141D Appendix G. Compared to the 3 kHz waveforms of MIL-STD-188-110B, the new wideband HF (WBHF) waveforms as per MIL-STD-188-110D Appendix D offer new possibilities. The added benefit of the WBHF family of waveforms is that different bandwidths can be selected to achieve different levels of communications service, e.g. robustness, latency and performance. For example, given a specific user data rate, it may be possible to select a wider bandwidth waveform that can provide the same throughput but requiring less SNR while at the same time providing more robustness to multipath and fading.

The WALE ALE controller automatically handles the management of frequency, channel selection (in a manner cognizant of availability, propagation and interference), link establishment and maintenance to potentially adapt the selected sub-channel and bandwidth.

WALE Waveforms

The WALE (4G ALE) system uses waveforms derived from the WBHF waveforms for its transmissions, and draws ideas from both second- and third-generation ALE for its protocols. The WALE waveforms operate in 3 kHz and provide two interoperable modes for sending PDU – the “Fast” WALE waveform (intended for very fast link setup in voice-quality channels) and the “Deep” WALE waveform (designed for operation in the most challenging channels, including SNR < 0 dB).

The choice between Fast or Deep WALE can be made on a call-by-call basis as receivers listen to both types of WALE calls, as well as 3G & 2G ALE calls for simultaneous operation with existing narrowband circuits.



MIL-STD-188-141D APPENDIX G – WALE/4G ALE	
WALE PROTOCOL	<p>WALE/4G protocols use a 96-bit protocol data unit (PDU). Synchronous and asynchronous link Setup. 2-way (LSU Request, followed by LSU Confirm) and 1-way (LSU Request). Point-to-Point, Point-to-Multipoint and Broadcast link setup. Channel quality estimation by means of Wideband occupancy detection and LQA (Listen-before-Transmit (LBT) and listen-before-response (LBR)) exchanges. Excellent performance in degraded HF channels by means of robust burst waveforms. Automatic channel selection for calling channels. Wideband traffic channel negotiation: 2-way, 3-way and with override. 4G Text and Binary Message PDUs Utility Protocols – Late net entry, Data fill distribution, Time of day distribution, Synchronization maintenance and Time Broadcast</p>
WALE ADDRESSES	<p>User process and PDU addressing are supported.</p> <ul style="list-style-type: none"> ALE PDU addresses are 16-bit binary numbers for individual nodes and multipoint groups. In addition, support for 16-bit network number for NATO applications and used as part of the linking protection process is provided. WALE user process addresses are alphanumeric characters with lengths from 3 to 15 printable ASCII characters (not send OTA).
WALE WAVEFORMS	<p>Two WALE waveforms (3 kHz in bandwidth) are used:</p> <ul style="list-style-type: none"> The “Fast” WALE waveform is intended for very fast link setup in voice-quality channels. The “Deep” WALE waveform is designed for operation in the most challenging channels, including SNR < 0 dB. Both “Fast” and “Deep” WALE waveforms include half rate, constraint length 9 (CL-9) FEC; block interleaving and 8-PSK modulation. TLC sections and capture probes are included for asynchronous calls and asynchronous terminations.
SCANNING OPERATION	<p>Scanning entails listening for calls and sounding transmissions. Asynchronous scanning: No time synchronization is assumed. System dwells on each channel for the minimum dwell time. Synchronous scanning: Time synchronization is required. System dwell periods are synchronized to the start of a GPS epoch. Support for multiple dwell times:</p> <ul style="list-style-type: none"> Mixed 3G / 4G Networks. Scans at 3G ALE speed, with a synchronous dwell time of 1.35 s. 4G Network with support for both Fast & Deep WALE. Synchronous dwell time is 675 ms. 4G Network with support for Fast WALE only. Synchronous dwell time is 450 ms.
CHANNEL RECORDS/ OCCUPANCY DETECTION	<p>Up to 100 channel records containing information for a channel (e.g. frequency of data and ALE transmissions, assigned sub-channel vector defining the contiguous bandwidth, occupancy records). Occupancy detection (used during LBT & LBR) based on integrated energy detection for the wideband channel.</p>
LINKING PROTECTION	<p>HALFLOOP Linking Protection, 128-bit key. HALFLOOP-96 (4G ALE PDUs), HALFLOOP-48 (3G ALE/FLSU PDUs), HALFLOOP-24 (2G ALE PDUs)</p>

RM10 HF MODEM ORDERING INFORMATION		STOCK NUMBER	DESCRIPTION
HF	RM10 Wideband SDM - WBHF Modem (MS-188-110C)	RME-M0-RA-W1V06	SDM: RM10 W1 (110ABC 24kHz 120kbps) V06
	OPTION: 4G WALE UP TO 24 KHz (MS-188-141D), INCL. 2G & 3G	M10-SW-O-4G-V06	SW MDL-4G (WALE 141D 24kHz 2G 3GLSU) V06
OTHER RM10 VARIANTS		STOCK NUMBER	DESCRIPTION
V/UHF	RM10 Wideband SDM - UHF Modem (STANAG 4691)	RME-M0-RA-U4V06	SDM: RM10 U4 (UHF 4691-B, 25kHz) V06
	RM10 Wideband SDM - VHF Modem RM V6	RME-M0-RA-V6V06	SDM: RM10 V6 (V/UHF 24kHz 128kbps) V06

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