Harris HF Wideband ALE

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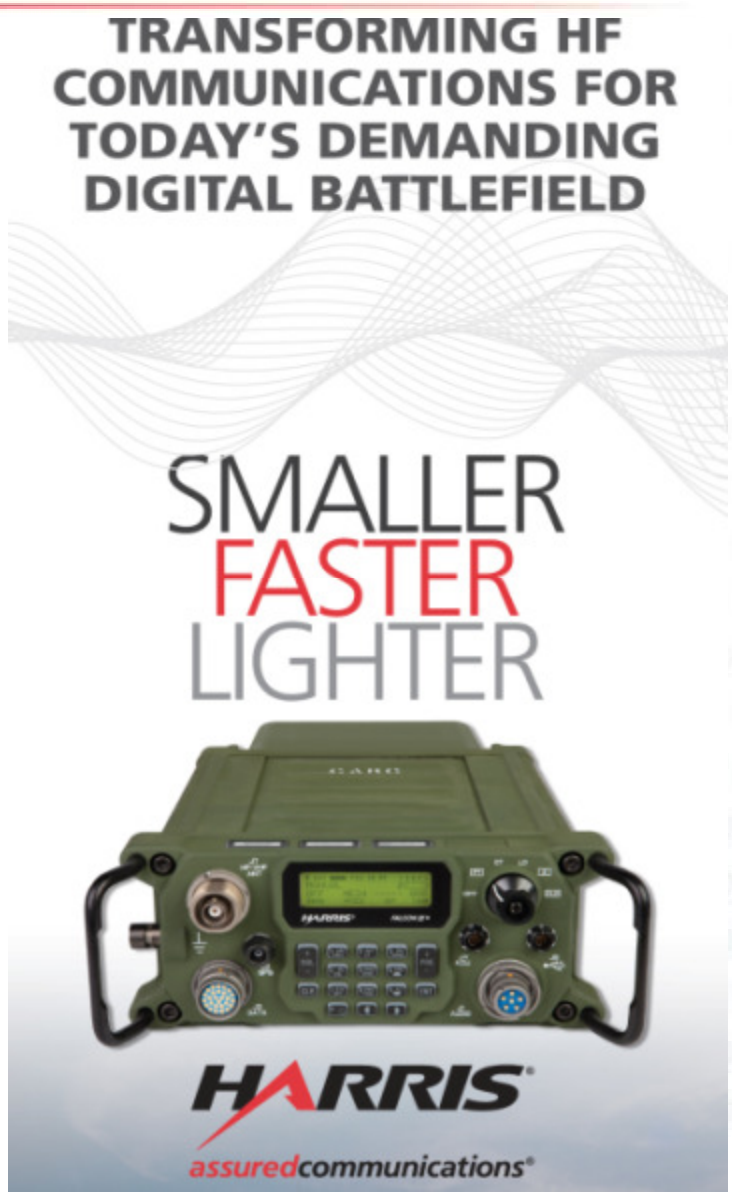
Wideband Capability that is available today




Harris Adaptive Wideband ALE

US MIL-STD-188-110C Wideband HF

- US MIL-STD-188-110C Appendix D (110C-D) defines a wideband HF data modem which supports eight bandwidths from 3 kHz to 24 kHz, in increments of 3 kHz allowing user data rates from 75bps to 120 Kbps.

- Harris Corporation has implemented within the RF-7800H-MP the modem technology that extends the high performance serial tone modem of the original MIL-STD-110B standard to these wider bandwidths.

- Harris and Rockwell Collins 110C-D modem implementations have been shown to interoperate

Need for Adaptive Wideband

- The 110C-D standard defines a family of wideband non ARQ HF Fixed frequency data modem waveforms that are not adaptive.
- Proper selection of bandwidth and modulation characteristics will require automation in order for wideband HF to be used effectively in the field.
- Harris has implemented a wideband adaptive ALE data capability in the RF-7800H wideband manpack.

Waveform Number	Modulation	Data Rate				
		3 kHz	6 kHz	12 kHz	18 kHz	24 kHz
0	Walsh	75	150	300	600	600
1	BPSK	150	300	600	1,200	1,200
2	BPSK	300	600	1,200	2,400	2,400
3	BPSK	600	1,200	2,400	4,800	4,800
4	BPSK	1,200	2,400	4,800	-	9,600
5	BPSK	1,600	3,200	6,400	9,600	12,800
6	QPSK	3,200	6,400	12,800	19,200	25,600
7	8PSK	4,800	9,600	19,200	28,800	38,400
8	16QAM	6,400	12,800	25,600	38,400	51,200
9	32QAM	8,000	16,000	32,000	48,000	64,000
10	64QAM	9,600	19,200	38,400	57,600	76,800
11	64QAM	12,000	24,000	48,000	72,000	96,000
12	256QAM	16,000	32,000	64,000	90,000	120,000
13	QPSK	2,400				

Harris WB ALE

- Customer requirements for a WB ALE system:
  - Ease of use
  - Interference avoidance
  - Backward interoperable with customer systems already using STANAG 4538 (“3G mode”) – such as more than 100,000 Harris Falcon II HF radios fielded

- Harris has developed a WB ALE capability that adaptively selects the best channel, and determines the available bandwidth and frequency offset required for optimal wideband HF communications.

Harris WB ALE

- The current RF-7800H Wideband solution:
  - Harris WB ALE is based on 3G (STANAG 4538 Fast Link Setup (FLSU))
  - To establish a wideband link:
    - The calling station first places a call using STANAG 4538 FLSU.
      - The standard FLSU Request PDU has a traffic type parameter; we use a new value of this parameter (reserved but not defined in STANAG 4538) to indicate that a wideband link is to be established.
      - If either the calling radio or radio being called is not wideband capable, then the traffic type parameter value specifies that a narrowband(normal STANAG 4538 FLSU) link is to be established.
    - The radios then use an additional handshake (not defined in STANAG 4538) to negotiate bandwidth and offset to be used, based on the results of spectrum sensing.

Harris WB ALE

Spectrum Sensing

- Increased bandwidth results in a greater likelihood of interference
- A WB system requires capabilities to detect, and avoid interfering signals
- Passive Spectrum Sensing is taking place while scanning – gaining information on the local interference environment on the 24kHz spectrum of the scanned channels
- Observation interval short enough to permit sensing within FLSU dwell period (analogous to 'Listen-Before-Transmit')

Spectrum sensing examples

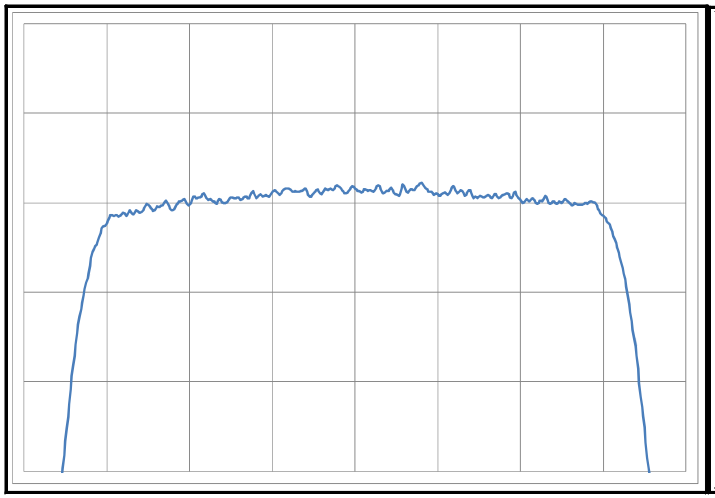


Figure 1. No signal

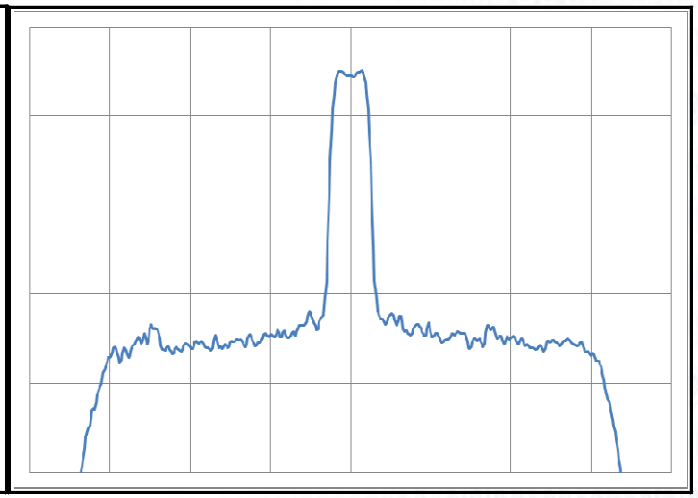


Figure 2. 3 kHz probe

- Figure 1 depicts the spectral profile of a channel from which interference is absent: a mostly flat spectrum of the local noise floor
- Spectrum sensing can also be performed while receiving a known signal – in this case, a 3 kHz 3G ALE probe signal
- Observed spectrum provides an estimate of SNR and allows for adjustment of bandwidth and modulation

Use of spectrum sensing

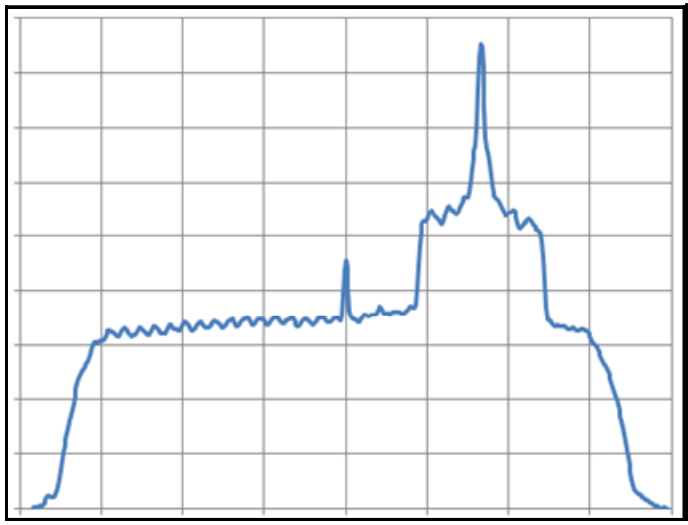


Figure 3. AM interferer

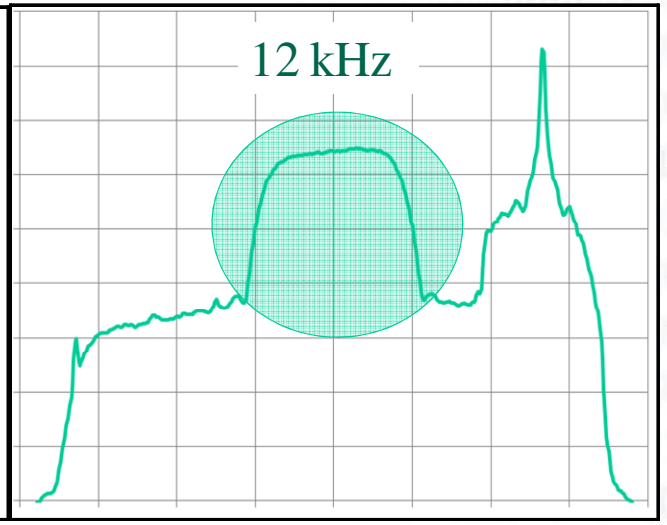


Figure 4. Interference avoided

- Figure 3 shows a spectral profile containing a prominent interfering signal: in this case, an AM broadcast signal
  - Attempted to pass data at 64 kbps, 24 kHz bandwidth: 50% BER
- In Figure 4, we see that the transmitter has limited its bandwidth to 12 kHz and added a frequency offset
  - By sidestepping the interference, was able to pass data error-free at 32 kbps

Harris Adaptive WB ALE

- Ease of Use – Adaptive
- Dynamically avoids interference
- Adaptively selects BW, frequency offset, and data rate based on observed channel conditions
- Data rate automatically adapts during link due to changing channel conditions
- Interoperability with widely deployed Harris Falcon II STANAG 4538 3G systems – Allows for mixed WB/NB radio networks
- This capability is being shipped with our RF-7800H-MPs today

- Rockwell and Harris are members of the MIL-STD WBHF ALE Technical Advisory Committee, looking at a way to standardize a Wideband ALE solution.

RF-7800H Wideband HF/VHF Manpack

HARRIS
assuredcommunications®

- Smallest, lightest and fastest wideband HF manpack radio
- Fully interoperable with Falcon II® HF radios and accessories
- Secure, reliable communications over the most challenging channel conditions
- Leveraging a half-century of market-leading innovation in HF tactical communications

Transforming HF Communications for Today's Demanding Digital Battlefield