



ECE 495 – Electromagnetic Warfare and Survivability

Block 2: RF Electronic Warfare Lesson 17: Electromagnetic Attack

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L15–L16 were **EP**: protect *our* use of the spectrum — hide, hop, spread, survive.

Now switch sides. **EA** is the offense: deny the *enemy* their radars and links. Everything the threat did to us in ES and EP, we now turn around.

Today: the jamming toolkit, the J/S scorecard, and the range where it all unravels.

By the end of this lesson, you will be able to:

- Define **EA** and place it against ES and EP
- Classify **noise jamming**: spot, barrage, and swept-spot
- Compute the **J/S ratio** for a self-protect jammer
- Explain and find the **burn-through range**

EA uses EM energy to **deny, degrade, or disrupt** the enemy's use of the spectrum.

- **Jamming** — raise the noise floor so real returns vanish
- **Deception** — inject false returns so the radar believes a lie (L18)
- **Directed energy** — burn the receiver itself (beyond our scope)

ES listens, EP shields — EA reaches out and breaks the threat's picture.

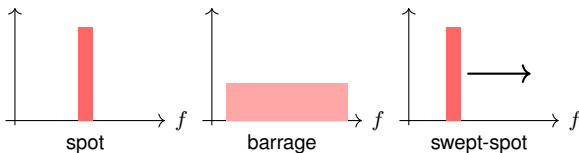
Two Ways to Lie to a Radar



	Cover (noise)	Deception
Goal	Hide the real return	Create false returns
Method	Raise the noise floor	Mimic / replay the signal
Effect	Radar sees <i>nothing</i> clearly	Radar sees the <i>wrong</i> thing
Today	Yes	Preview — full treatment in L18

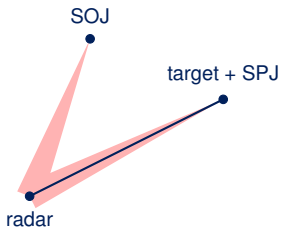
- Noise **denies** information; deception **corrupts** it
- Today is the noise half — and the math that governs it

Noise Jamming: Spot, Barrage, Swept



- **Spot** — all power on one band: high density, but agility escapes it (L15)
- **Barrage** — whole band at once: jam-proof to hopping, but power per Hz drops
- **Swept-spot** — sweep a spot across the band: trades dwell time for coverage

Where the Jammer Sits



- **Self-protect (SPJ)** — jammer rides the target it defends
- **Stand-off (SOJ)** — a dedicated platform jams from safe range
- **Escort / stand-in** — jam from alongside or from deep inside the threat ring

Geometry sets the range R in the J/S equation — and who is at risk.

J/S is the *effective* jamming power in the receiver passband over the signal power. For a self-protect jammer:

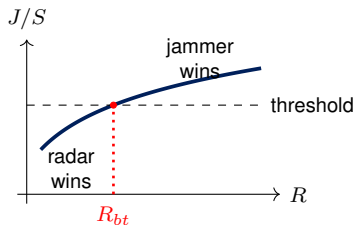
$$\frac{J}{S} = \frac{4\pi P_j G_j R^2}{P_t G_t \sigma}$$

- Skin echo $S \sim 1/R^4$; jammer (one-way) $J \sim 1/R^2$ — so $J/S \sim R^2$
- Above ~ 10 dB jamming dominates — but can trip the radar's anti-jam modes
- Only the power *in the passband* counts — bandwidth, gain, and range all matter

Burn-Through Range



Because $J/S \sim R^2$, the jammer wins far out and *loses* as the target closes.



- Inside R_{bt} the radar **burns through** and re-detects
- Falling J/S also strips advanced ECM (range-gate pull-off, deception)
- Modern pulse-Doppler tolerates J/S up to $\sim +10$ dB

Lower RCS pulls R_{bt} *inward* — LO and jamming reinforce each other.

Today's Interactive Demo: Find Burn-Through

Today's interactive demo.

- Build the self-protect J/S equation for a notional radar and jammer
- Sweep range and plot J/S in dB — watch it climb as R^2
- Read off the **burn-through range** where J/S crosses the threshold

Companion script: L17_JtoSBurnThrough.m

Then halve the RCS and see the burn-through bubble shrink.

Quick Exercise / Type-along: Work the J/S



A self-protect jammer faces a threat radar. Reason about each:

1. The target halves its range to the radar. What happens to J/S, in dB?
2. Why does a stand-off jammer not get this same range relief as it closes?
3. The target also cuts its RCS by 10 dB. Which way does burn-through move?
4. When would a barrage jammer beat a spot jammer against the same threat?

Key ideas:

- EA denies, degrades, or disrupts the enemy's spectrum
- Noise jamming comes as spot, barrage, or swept-spot
- Self-protect J/S grows as R^2 — the jammer's edge fades as you close
- Burn-through is where the radar wins back the target

Next lesson:

- **L18: Active deception** — DRFM, false-target injection, towed decoys
- Pre-flight quiz for L18 due before class