Antenna Theory

Exploring a ¼ wavelength element driven with a square wave

Background

What we know from EMC emissions & immunity testing:

- Clock harmonics and broadband noise emissions are maximized by 1/4 wavelength conductors and slots in shields
- Susceptibility is increased by 1/4 wavelength conductors and slots in shields

What we know from transmission lines:

- In high speed digital signaling we control impedance and minimize reflections for signal integrity

What we know from radio transmitters:

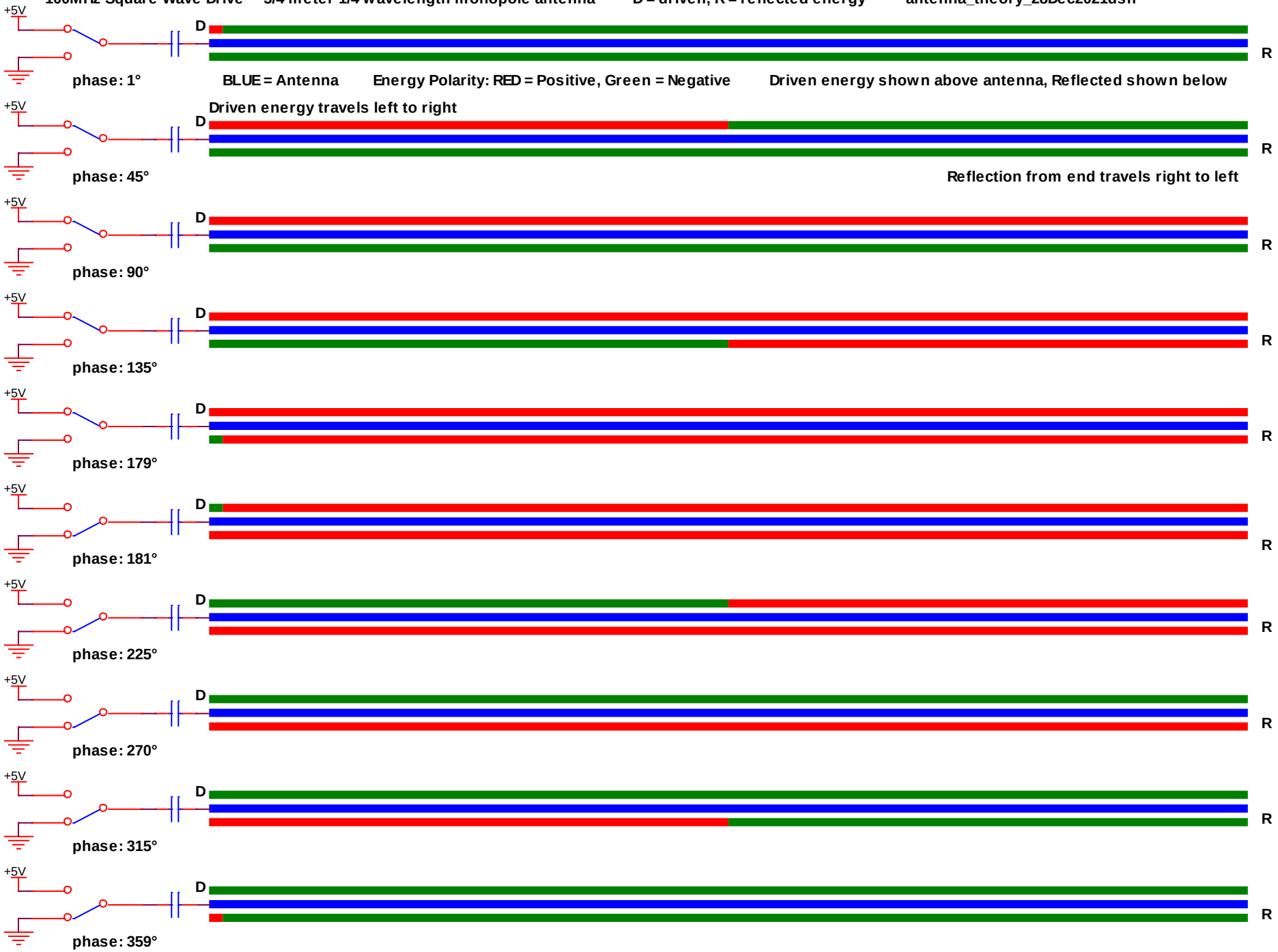
- 1/4 wavelength monopoles and 1/2 wave dipoles are efficient radiators

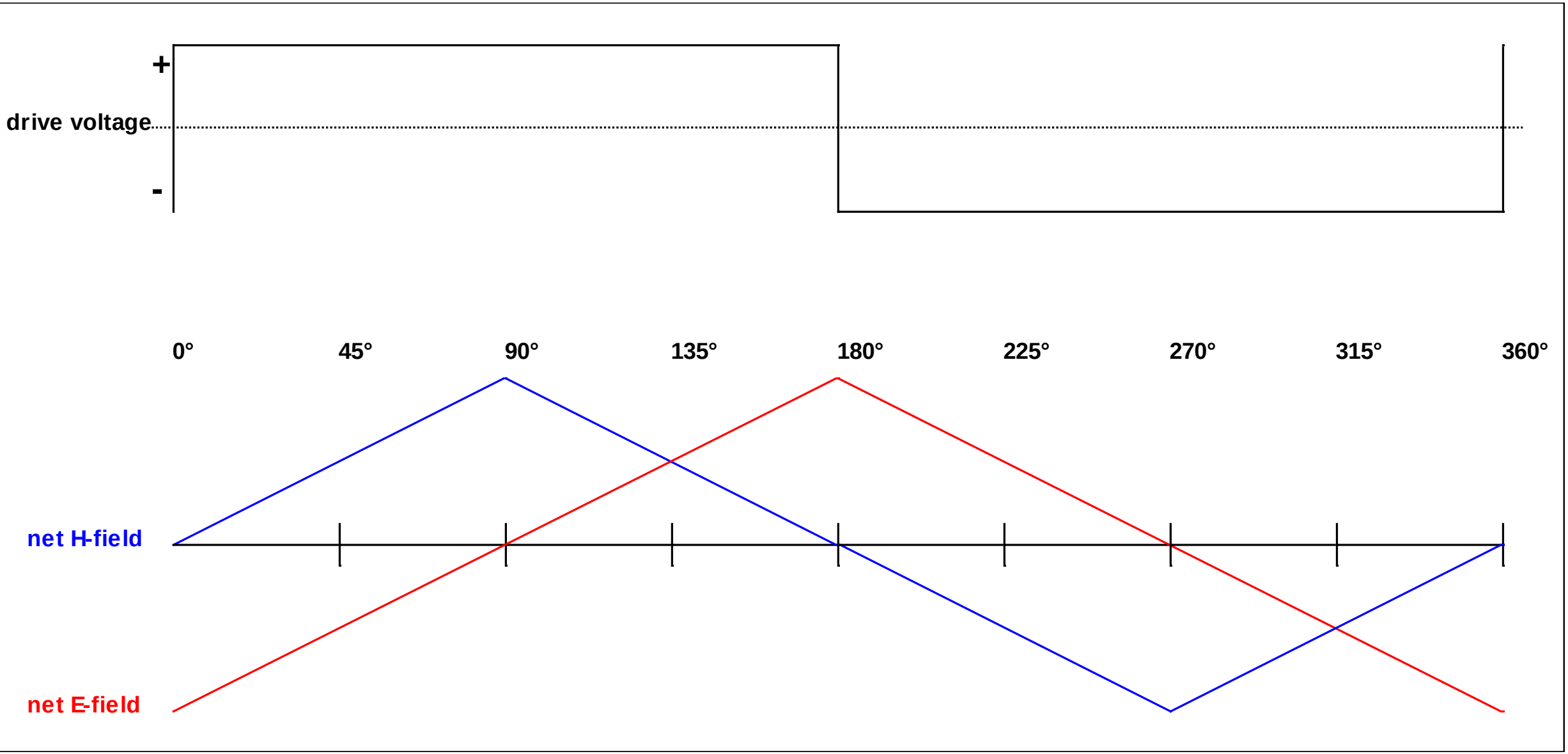
Transmission Lines vs Antennas

In a transmission line, H-field cancellation between the conductors controls the impedance (via conductor spacing and geometry)

In an antenna, H-field cancellation around a single conductor is the result of reflected energy

A 1/4 wavelength conductor maximizes the H-field cancellation and minimizes the impedance


100MHz Square Wave Drive
3/4 meter 1/4 wavelength monopole antenna
D = driven, R = reflected energy
antenna_theory_28Dec2021dsn
+5V
D
R
phase: 1°
BLUE = Antenna
Energy Polarity: RED = Positive, Green = Negative
Driven energy shown above antenna, Reflected shown below
Driven energy travels left to right
phase: 45°
Reflection from end travels right to left
phase: 90°
phase: 135°
phase: 179°
phase: 181°
phase: 225°
phase: 270°
phase: 315°
phase: 359°


+
drive voltage
-
0°
45°
90°
135°
180°
225°
270°
315°
360°
net H-field
net E-field