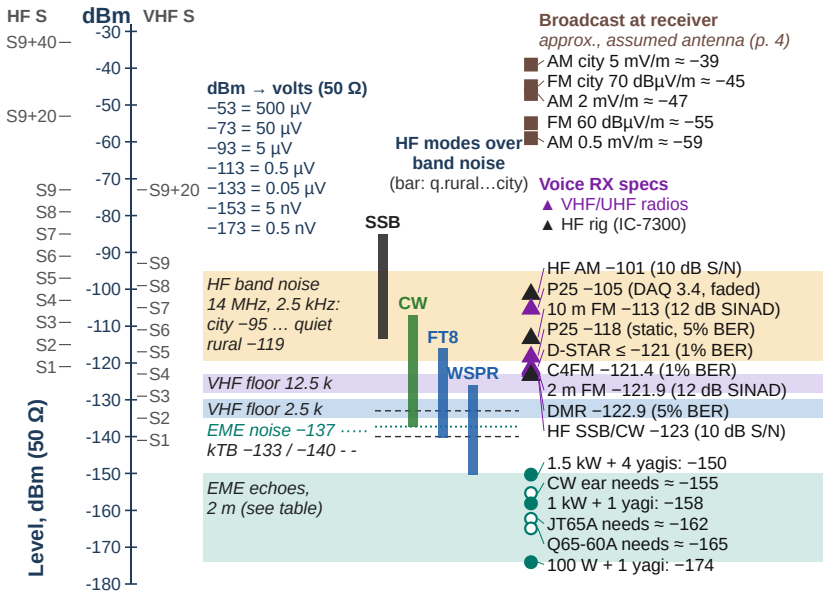
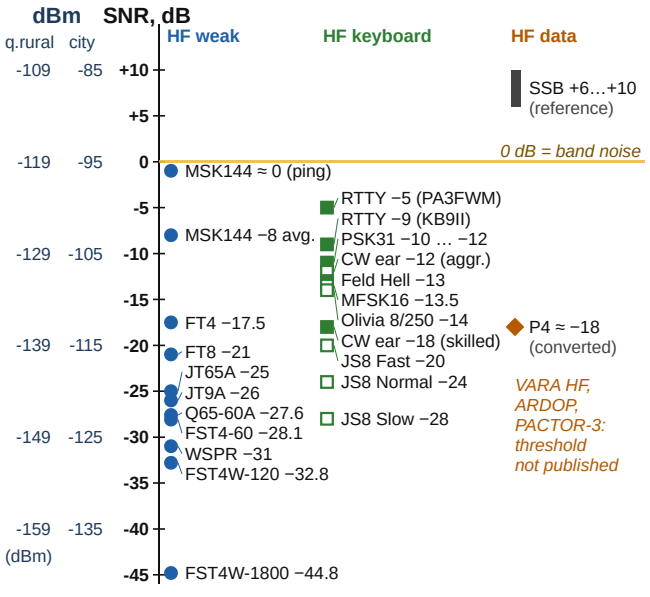
Decibel Scales Quick Reference: AE4JC

A = level; B = SNR in 2500 Hz, ≈ an SSB filter (why: p. 3 §4). *Amber italic = rule of thumb.*

A · Level at the antenna jack: dBm axis (50 Ω), S-units either side



B · Required SNR in 2500 Hz (dB axis; dBm equivalents left)



● filled = sourced, 2500 Hz · ○ □ hollow = basis not stated / rule of thumb · ▲ = radio spec, dBm at stated BER · ◆ = converted bandwidth · B dBm = SNR + floor

Assumptions. dBm = SNR_{2500} + floor. HF floor: ITU-R P.372 median man-made noise, 14.2 MHz, F_a = c − d·log f → quiet rural / rural / residential / city **−119 / −105 / −99 / −95 dBm in 2.5 kHz** [23]; antenna and neighbors move it. VHF/UHF floor = kTB + NF (5–10 dB, rule of thumb). Voice markers are radio specs, not conversions. Read markers as ±3 dB. Quiet rural HF F_a ≈ 21 dB is near a 10–20 dB rig NF, so a preamp can help there.

Typical receiver NF	
HF transceiver, no preamp	*10–20 dB* [24]
VHF/UHF transceiver	*5–10 dB* [24]
Mast-head 2 m preamp	<0.5 dB (PGA144) · 1.2–1.3 incl. relays [25]
SDR dongle (RTL-SDR Blog V4)	not published [26]
Starlink dish	not published

EME worked example, 144 MHz, own echo: echo = P + 2G − L · noise −137.3 dBm (0.031 µV) in 2500 Hz, T_{sys} ≈ 535 K (sky ≈ 500 K [23] + 0.5 dB preamp)

Strong echo → Weak

Station (assumed)	P at antenna	Gain	EIRP	Path loss	Echo	SNR_{2500}	What decodes
1.5 kW, 4-yagi array	+61.8 dBm	20 dBi [29]	81.8 dBm / 51.8 dBW	252.1 dB	−150 dBm (6.8 nV)	−13.0 dB	CW echoes audible; JT65/Q65 with margin
1 kW, single long yagi	+60 dBm	*17 dBi*	77 dBm / 47 dBW	252.1 dB	−158 dBm (2.8 nV)	−20.8 dB	JT65A, Q65 yes; CW by ear no
100 W, single yagi	+50 dBm	*14 dBi*	64 dBm / 34 dBW	252.1 dB	−174 dBm (0.44 nV)	−36.8 dB	None, even Q65-300A; needs a big partner

Path loss (radar eq., η 0.065; perigee / **mean** / apogee): 144 MHz 250.8/**252.1**/253.1 · 432 MHz 260.3/**261.6**/262.6 · 1296 MHz 269.9/**271.2**/272.2 dB. The common 252/261/271 dB figures [27] are mean-distance values; perigee to apogee spans ≈2.3 dB. JT65 works 10–15 dB below ear CW [28].

Strong signal needed ↓ → Decodes weakest

Group	Mode	Threshold SNR_{2500} dB · B: dBm	Bandwidth	Good looks like	Src
▮ **A** Ref. voice ▂▄▆▇	*SSB · AM voice*	+6 … +10 · AM −101 dBm (2.0 µV), 10 dB S/N	≈2.5 · 6 kHz	The baseline digital modes beat	[3][4][30]
▲ **B** V/UHF voice dBm ▂▄▆▯	P25 (C4FM)	−105 DAQ 3.4 (faded) · −118 static (5%)	12.5 kHz	Design for faded DAQ 3.4	[40][41]
	D-STAR · C4FM	≤ −121.0 (1% BER) · −121.4 (1% BER)	≤6 kHz · 9.6 kbps	≈ VHF S4 (R.1, calc)	[14]–[16]
	FM voice (ref.)	≤ −121.9 (12 dB SINAD)	voice channel	Threshold effect: fine, then gone	[15][5]
	DMR Tier II	−122.9 (5% BER)	12.5 kHz TDMA	Digital, 2 slots	[18]
	M17 · NXDN	not published · not verified	9 · 6.25/12.5 kHz	Open 4FSK · FDMA 4FSK	[19][20]
– **C** V/UHF data ▂▄▆▯ (not on chart)	AX.25 1200 / APRS	audio SNR 6 kHz (sim.): fails < ≈+1; FX.25 −1	Bell 202 in FM	144.390 MHz (N. America)	[13][22]
	9600 packet · VARA FM	not published	not verified	*Need a flat data port*	[10]
■ **D** HF keyboard ▂▄▯▯	RTTY 45.45 bd/170 Hz	−5 (PA3FWM) … −9 (KB9II)	270 Hz	No FEC: copy collapses fast	[3][4][6]
	PSK63 · PSK31	*−7 · −10…−12 (MultiPSK −11.5)*	≈160 · ≈31–80 Hz	Tune within ≈10 Hz	[3][4][7]
	Olivia · Contestia	*32/1000 −12, 8/250 −14 · 8/250 −13*	1000/500/250 Hz	Contestia 2× faster, 0–2 dB worse	[6]
	Feld Hell · MFSK16	−13 avg (−7 peak) · *−13.5*	≈250–300 · 316 Hz	Hell is read by eye	[4][7]
	CW ear · CW Skimmer	*−12 aggr.* … −18 skilled · not published	keying-dependent	Skimmer: key-on SNR in 500 Hz	[3][5][8]
	JS8 60/40/Fast/Norm/Slow	*−16 / −18 / −20 / −24 / −28*	250/160/80/50/25 Hz	Start in Normal	[2]
◆ **E** HF data ▂▯▯▯	PACTOR-4 · -3	≈ −18 (−20 @ 4 kHz) · not single-valued	2.4 · 2.2 kHz	SCS hardware; P4 led N5TW sims	[12][13]
	VARA HF	not published (5,629 bps at +16.5 dB, calc)	500/2300/2750 Hz	Proprietary shareware	[9][10]
	ARDOP	not published	200 … 2000 Hz	Open protocol	[11]
● **F** HF weak ▂▯▯▯	MSK144 *(6 m/2 m MS)*	≈0 per ping (40% at −1.5) · −8 averaged	≈2.4 kHz	Short strong meteor pings	[1]
	FT4 · FT8	−17.5 · −21	83.3 · 50 Hz	Any decode counts; FT4 = speed	[33][34]
	JT65A · JT9A	−25 · −26	177.6 · 15.6 Hz	JT65 for EME; JT9 in <10% width	[33]
	Q65 15A…300A	−22.2 … −33.8	433 … 19 Hz	Longer T/R = deeper; EME, scatter	[33]
	FST4 · WSPR · FST4W	−20.7…−43.2 · −31 · −32.8…−44.8	66.7…0.36 · 5.9 Hz	Beacons; LF/MF	[33]

Top = needs the most signal, bottom = decodes deepest; rows by range midpoint, "not published" last; *italic* = basis not stated. ▂▄▆▇ = rank here, not a measurement. Shapes/colours match the scale: ▮ SSB bar, ▲ radio specs, ■ keyboard, ◆ data, ● weak; – C is not on the chart (audio-SNR spec only). B is dBm, placed after the analog reference.

Sources, page 1 (plus [33][34][40][41] on page 2) · full chart: p. 2 · explainer: p. 3 · broadcast vs ham: p. 4

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Decibel Scales: the full chart

Vrms column = voltage into 50 Ω, computed from P = V²/50 and dBm = 10·log$_{10}$(P / 1 mW). *Italic amber = rule of thumb, not a standard.* [n] = source below. **Mode scale & EME: page 1.**

Scale · landmark	Value	Vrms @50 Ω	Reference (what 0 dB means) · what "good" looks like	Src
dBm: absolute power, 0 dBm = 1 milliwatt (each +10 dB = ×10 power; each +3 dB ≈ ×2)				
1 kW (microwave-oven magnetron class)	**+60 dBm**	224 V	Pure math: 1000 W = 10^6 mW. Ovens vary (roughly 600–1200 W).	calc
100 W HF transceiver	**+50 dBm**	70.7 V	= +20 dBW. Going to 1.5 kW is only +11.8 dB (about 2 S-units at the far end).	calc
5 W handheld (HT)	**+37 dBm**	15.8 V	Exactly +36.99 dBm. 100 W vs 5 W is 13 dB, a bit over 2 S-units.	calc
1 W	**+30 dBm**	7.07 V	= 0 dBW. FCC cap on conducted output for 2.4 GHz digital-modulation (Wi-Fi-type) devices, §15.247(b)(3).	[46]
Wi-Fi router transmitter	**≈ +20 dBm**	2.24 V	100 mW. *Typical consumer value, not a spec*; actual TX power varies by router, band, and region.	[46]
1 mW	**0 dBm**	224 mV	The reference point itself. Everything below here is negative, which is normal for receivers.	calc
S-meter: IARU Region 1 Technical Recommendation R.1 (Brighton 1981; amended Torremolinos 1990): 1 S-unit = 6 dB (= 2× voltage, 4× power)				
HF S9+20 dB	**−53 dBm**	501 µV	"20 over 9." Strong, comfortable SSB.	[31]
HF S9 (bands below 30 MHz)	**−73 dBm**	50.1 µV	Defined as available CW-generator power at the antenna jack; 50 µV into 50 Ω = −73.01 dBm = 34 dBµV.	[31,32]
HF S5	**−97 dBm**	3.16 µV	Four S-units (24 dB) below S9.	[31]
HF S1	**−121 dBm**	0.20 µV	48 dB below S9. Computed 0.199 µV (R.1 table: 0.21 µV). *Real rigs are rarely calibrated to R.1, especially at the low end; treat S-readings as relative.*	[31]
VHF/UHF S9 (above 30 MHz)	**−93 dBm**	5.0 µV	R.1: "On the bands above 30 MHz this power shall be −93 dBm." 20 dB lower than HF because thermal noise, not band noise, limits VHF. VHF S1 = −141 dBm (0.020 µV).	[31,32]
Thermal floor (kTB), 2.5 kHz	**−140 dBm**	0.022 µV	Ideal noise floor (290 K, perfect 0 dB-NF receiver), not a real SSB noise floor. −174 dBm/Hz + 10·log$_{10}$(2500) = −140.0 (2.4 kHz: −140.2). Real floor = kTB + receiver NF; on HF, atmospheric and man-made noise usually sit far above that.	[48,49]
Signal-quality scales: ratios in dB, or received levels in dBm with their own comfort zones				
FT8 / WSJT-X SNR	**−21 dB**	–	0 dB = signal power equals noise power **in a 2500 Hz reference bandwidth** (FT8 itself is only 50 Hz wide). Threshold ≈ −21 dB (50% decode): −20.8 dB AWGN without a-priori info, −22.7 dB with maximum a-priori. Visible on the waterfall ≈ −26 dB, audible ≈ −15 dB. At 14 MHz noise, threshold ≈ −140 … −116 dBm (0.02–0.35 µV).	[33,34]
Wi-Fi RSSI (as dBm)	**−67 dBm**	100 µV	−30 "amazing" (only a few feet from the AP) · **−67 minimum for voice/video** (Cisco design guide; assumes ≥25 dB SNR over a −92 dBm noise floor) · −70 OK for web/email · −80 "not good": basic connectivity, unreliable; −90 unusable. *−30 to −50 "excellent" is vendor rule of thumb.* 802.11 itself only sets receiver sensitivity per rate (e.g. −82 dBm at 6 Mb/s, 20 MHz OFDM).	[35–37]
Cellular LTE/5G RSRP	**−80 dBm**	22.4 µV	Power of one reference-signal resource element, so it reads well below RSSI. *≥ −80 excellent · −80 to −90 good · −90 to −100 fair · < −100 poor* (vendor bins; 3GPP defines the measurement, not the grades). LTE RSSI = total wideband power incl. noise and interference, so don't judge by it alone.	[38,39]
Cellular SINR	**≥ 20 dB**	–	*≥ 20 dB excellent (clean) · 13–20 good · 0–13 fair · ≤ 0 poor.* SINR, not raw strength, decides your data rate.	[38]
P25 digital radio (C4FM)	**−105 dBm**	1.26 µV	Own thresholds, not cellular bins. Typical radio: static sensitivity ≈ −118 dBm (5% BER); ≈ −105 dBm mean signal for DAQ 3.4 in fading. TSB-88 design criterion: C4FM DAQ 3.4 (2% BER) needs faded Cf/(I+N) ≈ 17.7 dB. Radios rarely show "SINR"; systems are designed in C/(I+N) and BER.	[40,41]
Starlink: direct-to-cell (phone ↔ satellite, cellular PCS band) and Ku-band dish				
Direct-to-cell RSRP	**≈ −121 dBm**	0.20 µV	Median, US crowdsourced, Oct 2024–Jul 2025 (vs −97 dBm T-Mobile terrestrial; spread 21 dB). Ookla: −120 dBm crowdsourced (Oct 2025–Sep 2026), −118 dBm in 2026 RootMetrics drive tests (moving cars). Deep in the "poor" bin, yet it carries SMS.	[50,51]
Direct-to-cell SINR	**≈ 0 dB**	–	Median 0 dB (vs 5 dB terrestrial). RootMetrics median RSSNR 3.0 dB. Far below terrestrial norms; fine for texts, a few Mb/s per beam at best.	[50,51]
Ku dish SNR	**16–17 dB**	–	Modeled: 550 km link budget gives 17.35 dB suburban down to 16.54 dB rural, all >16 dB. *Mid-teens to low-20s = healthy.* The Starlink app shows "signal quality" as a % of SNR, not dB.	[52,53]
Obstruction %	**0 %**	–	Starlink Business dashboard guide: "Any obstruction level is bad"; **>0.2 %** hurts performance; **>0.27 %** causes outages users notice.	[53]
Free-space path loss (Ku, 11.7 GHz)	**≈ 169 dB**	–	Calc per ITU-R P.525: 168.6 dB at 550 km zenith · 174.8 dB at 25° elevation (1,123 km slant) · 204.9 dB for GEO at 35,786 km. User terminal max EIRP 38.2 dBW, TX gain 34.6 dBi (one SpaceX FCC filing, early terminal) [54].	[66] calc
Doppler & handover	**±209 kHz**	–	Calc, 11.7 GHz, v = 7.59 km/s: ±209 kHz at 40° elevation, ±247 kHz at 25°, ±273 kHz at horizon (ignores Earth rotation). Scheduler re-plans every 15 s; measured satellite change ≈ every 27 s on average.	[55,56]
Other dB units you'll see on spec sheets				
dBi / dBd: antenna gain	**2.15 dBi**	–	dBi = vs. an isotropic point source; dBd = vs. a half-wave dipole. Dipole = 2.15 dBi = 0 dBd, so dBi = dBd + 2.15. Same antenna, two numbers.	[42]
dBc: relative to carrier	**−43 dBc**	0.50 V	FCC §97.307: HF spurs/harmonics ≥ 43 dB below the fundamental (transmitters installed after 1/1/2003); 30–225 MHz ≥ 60 dB (≤25 W: ≥40 dB and ≤25 µW). More negative = cleaner. On 100 W of CW: 5.0 mW (0.50 V).	[43]
dBµV: 0 dB = 1 µV	**34 dBµV**	50 µV	In 50 Ω: dBm = dBµV − 107 (HF S9 = 34 dBµV). EMC: FCC Class B conducted limits 56–66 dBµV quasi-peak. US cable TV uses dBmV in 75 Ω (≥0 dBmV at the TV, +3 dBmV at a 30 m drop); 0 dBmV = 60 dBµV = −48.75 dBm.	[44,45]
dBµV/m: field strength	**60 dBµV/m**	1 mV/m	Volts per meter *in the air*, not at the jack: 20·log(E / 1 µV/m); the FCC writes "dBu." FM protected contour 60, city grade 70; AM primary 2 mV/m = 66. Needs an antenna assumption to become dBm (page 4).	[63,64]
dBf: hi-fi tuner sensitivity	**0 dBf**	0.27 µV	dB re 1 femtowatt: 0 dBf = −120 dBm. Voltage shown across 75 Ω (0.55 µV across 300 Ω). Tuner "13 dBf usable" = −107 dBm.	[68,70]
dBW: 0 dB = 1 W	**−158.5 dBW**	0.084 µV	dBW = dBm − 30. Satellite links: EIRP in dBW. GPS L1 C/A minimum received power −158.5 dBW (= −128.5 dBm) at a 3 dBi linearly polarized reference antenna (IS-GPS-200), below the noise and recovered by processing gain.	[47]
Noise figure (NF)	**dB**	–	NF = 10·log$_{10}$(noise factor): how much noise the receiver adds over kTB. Floor = −174 dBm/Hz + 10·log$_{10}$B + NF. *VHF/UHF/microwave: low NF (≈1 dB or less from a good LNA) pays off; HF: band noise dominates, so a higher NF is usually fine.*	[48,49]
dBFS: SDR full scale	**0 dBFS**	–	0 dBFS = the ADC's clipping point, so every reading is negative. *Good = strongest signals well below 0 dBFS (headroom) with band noise sitting above the ADC's own floor.* Waterfall floor in dBFS shifts with FFT size and gain; it is not dBm until calibrated.	[48]

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Decibels explained

1. A decibel is always "compared to something"

A decibel isn't an amount of anything on its own. It's a ratio, this thing compared to that thing, squeezed onto a log scale so huge ranges fit on one chart. The letters after "dB" tell you what you're comparing to. dBm means compared to one milliwatt. dBW, one watt. dBµV, one microvolt. dBi, an imaginary antenna that radiates equally in every direction. dBc, your own carrier. Plain "dB" with no letters means a difference between two things, like a gain, a loss, or a signal-to-noise ratio. A dB number without its reference doesn't tell you much.

2. Two numbers to memorize: 3 and 10

Add 3 dB and you've doubled the power; add 10 dB and you've multiplied it by ten. Six dB is double-double: four times the power and exactly twice the voltage, since power goes with voltage squared. That's why one S-unit is 6 dB. It's also why an amplifier moves the other station's meter less than the wattage suggests: 100 W to 1,500 W is 11.8 dB. Fifteen times the power sounds enormous, and on the meter it's two S-units. When a signal is right at the edge of copy, those two S-units can be the difference between a contact and no contact.

dB	power ×	voltage ×	Power, from 100 W		Voltage into 50 Ω, from HF S9 = 50 µV (−73 dBm) shown as µV or mV · dBm · HF S-meter	
			+dB (W)	−dB (W)	+dB	−dB
1	1.26	1.12	126 W	79 W	56.1 µV · −72 · S9+1	44.6 µV · −74 · S8+5
3	2.0	1.41	200 W	50 W	70.6 µV · −70 · S9+3	35.4 µV · −76 · S8+3
6 (1 S-unit)	4.0	2.0	400 W	25 W	100 µV · −67 · S9+6	25.1 µV · −79 · **S8**
10	10	3.16	1 kW	10 W	158 µV · −63 · S9+10	15.8 µV · −83 · S7+2
20	100	10	10 kW	1 W	500 µV · −53 · S9+20	5.0 µV · −93 · S5+4
30	1,000	31.6	100 kW	100 mW	1.58 mV · −43 · S9+30	1.58 µV · −103 · **S4**

Arithmetic: P = 100 W × $10^{dB/10}$; V = 50 µV × $10^{dB/20}$; dBm via P = V²/50. +6 dB ≈ 398 W; S-units per IARU R.1.

3. Negative numbers are normal, and usually what you want

Zero dBm is one milliwatt, and that's a lot of signal to put into a receiver. Almost everything a receiver hears is a tiny fraction of a milliwatt, so it comes out negative. An S9 signal on HF is −73 dBm, about 50 millionths of a volt. Wi-Fi at −50 dBm is a strong signal (vendor rule of thumb). On some scales negative is the goal: a harmonic at −43 dBc means it's 43 dB below your carrier, which is what the FCC asks for on HF. And on an SDR, dBFS is measured down from the point where the converter clips, so every reading is negative and you want your strongest signals comfortably below zero.

4. FT8 reports vs. S-meter readings, and why 2500 Hz

An S-meter calibrated to the IARU standard reads absolute power at the antenna jack, in dBm. Many real meters only approximate it. WSJT-X reports a ratio: signal power compared with the noise power in a standard **2500 Hz reference bandwidth** [33]. 2500 Hz is used because these modes are normally received through an ordinary SSB receiver, whose IF filter is about that wide [3]. One reference puts every mode on one scale (page 1, panel B): SSB voice needs about +6 to +10 dB, FT8 decodes near −21 dB, WSPR near −31 dB. A narrow signal only competes with the noise in its own bandwidth, so the conversion is $\mathbf{SNR_{2500} = SNR_{BW} - 10{\cdot}\log_{10}(2500/BW)}$, assuming flat noise. For a 50 Hz FT8 signal, $10{\cdot}\log_{10}(2500/50) = 17.0$ dB: the −21 dB decode limit is about −4 dB measured in 50 Hz. K1JT gives the same conversion for JT65: 2 to 6 dB in 2.7 Hz is roughly −28 to −24 dB in 2500 Hz [28]. An FT8 report gives the margin over the band noise at the receiving station, not the microvolts at its antenna jack.

5. Wi-Fi and ham radio use the same dBm, but they want very different numbers

A dBm is a dBm, so −73 dBm is the same power whether it's an S9 signal on 20 meters or a Wi-Fi signal. The difference is what each system has to do with it. An SSB voice needs a few kilohertz and a readable signal over the band noise, so S9 is a great signal on HF. Wi-Fi is pushing tens to hundreds of megabits through a channel 20 MHz or wider, so it needs a much bigger margin over the noise. That's why Cisco designs voice and video Wi-Fi around −67 dBm with 25 dB of SNR, and why a Wi-Fi link at −80 dBm is unreliable. Compare signals within a system, not across systems.

6. The dBi / dBd trap

Antenna gain is always compared to a reference antenna, and there are two in common use. dBi compares to an "isotropic" radiator, a point that radiates equally in every direction, which doesn't exist. dBd compares to a real half-wave dipole. A dipole has 2.15 dBi of gain, which by definition is 0 dBd. So the same antenna always reads 2.15 dB higher in dBi than in dBd. Check which one a spec sheet uses. A "5 dBi" mobile whip is about 2.85 dBd, under 3 dB better than a dipole.

7. Starlink: weak signals, judged by the sky view

Satellites are far away, and path loss grows with distance squared. At the dish's 11.7 GHz, the free-space loss to a Starlink satellite straight overhead at 550 km is about 169 dB; to a geostationary satellite it's about 205 dB [66]. Direct-to-cell phones use cellular spectrum instead (PCS, about 1990 MHz downlink [50]) and typically see around −120 dBm RSRP, "poor" by cellular standards, with SINR around 0 dB, and they still get texts through. The dish does better because it's a high-gain phased array, with modeled SNR of 16–17 dB. The dish changes satellites about every 27 s on average, so anything in the way, such as a branch or a roofline, blocks the beam sooner or later. That's why Starlink's headline number is obstruction percentage: their business dashboard guide says over 0.2% hurts performance and over 0.27% causes outages you'll notice. For a dish, a clear view of the sky matters more than any dB number.

Key figures: ideal thermal floor (kTB) −140 dBm in 2.5 kHz with a perfect receiver · FT8 decode limit ≈ −21 dB · Wi-Fi −80 dBm unreliable, −90 unusable; comfort bands come from vendors · P25 C4FM DAQ 3.4 needs ≈17.7 dB faded C/(I+N) · Starlink Ku free-space path loss ≈ 169 dB at 550 km, terminal EIRP 38.2 dBW per filing, Doppler up to ≈ ±247 kHz at 25° elevation, satellite change ≈ every 27 s.

Sources, continued

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[66] ITU-R P.525-5, free-space loss: see page 4. Doppler, voltage and dB ratios are calculated.

Ham vs Broadcast AM/FM

Same physics, opposite design goals. **Broadcast is engineered tens of dB above threshold**: a station's protected contour puts hundreds of µV to a few mV on your antenna. **Ham weak-signal work lives at threshold**: FT8 at −21 dB SNR, CW by ear around −18, EME echoes in nanovolts (page 1). *Amber italic = rule of thumb.*

1. Who transmits what

Service	Band	Power limits	Src
Commercial AM	535–1705 kHz per §73.14	Class A 10–50 kW · Class B 0.25–50 kW (10 kW max in 1605–1705 kHz) · Class C 0.25–1 kW · Class D 0.25–50 kW daytime. 50 kW = +77 dBm.	[61][57]
Commercial FM	88–108 MHz, 100 channels × 200 kHz	Max ERP by class: A 6 kW (100 m HAAT, 28 km) · B1 25 kW · B 50 kW (150 m, 52 km) · C3 25 kW · C2 50 kW · C1, C0 and C **100 kW** (C: 600 m HAAT, 92 km to the class contour). 100 kW = +80 dBm ERP.	[61][62]
Ham AM (HF)	amateur HF bands	Part 97 limit 1.5 kW **PEP**. At 100% modulation PEP = 4 × carrier, so the carrier is ≤ 375 W (+55.7 dBm) and **each sideband is ¼ of the carrier: 93.75 W, −6 dBc** (+49.7 dBm). A 100 W rig runs about a 25 W carrier on AM.	[65][71][72] calc
Ham FM repeater (2 m, 70 cm)	28–225 MHz · 430 MHz+	No FCC per-HAAT cap now; SERA (Southeastern Repeater Association) still applies its ERP-vs-HAAT policy. 28–225 MHz: 800 W ERP up to 100 ft HAAT, 400 W at 100–500 ft, 200 W at 500–1000 ft, 100 W at 1000 ft+. 430 MHz+: 800 W up to 1000 ft, 400 W above. Even 800 W is 21 dB below a 100 kW FM broadcaster.	[73] calc

2. Field strength is its own unit: dBµV/m

A broadcast contour is a **field strength**, volts per meter in the air, not a level at your radio. dBµV/m = 20·log(E / 1 µV/m), so 1 mV/m = 60 dBµV/m (the FCC writes "dBu"). To put it on the page-1 dBm scale you have to pick an antenna:

FM (matched antenna): P_r(dBW) = E(dBµV/m) − 20·log f(GHz) − 167.2 + G(dBi), the ITU-R P.525 conversion for a matched antenna; same as $P = E^2\lambda^2G/(480\pi^2)$. *Example:* 60 dBµV/m at 98 MHz on a half-wave dipole (2.15 dBi): 60 + 20.2 − 167.2 + 2.15 = −84.9 dBW = **−54.9 dBm** = 65 dBf ≈ 0.49 mV across 75 Ω.

AM (short whip): a whip much shorter than λ/4 gives an open-circuit voltage V = E × h_{eff}, with h_{eff} ≈ half the whip length [67]. *Example:* 1 m whip, 2 mV/m → **1 mV**. AM front ends are high-impedance, not 50 Ω, so page 1 shows that 1 mV *"as if across 50 Ω" (−47 dBm): approx., assumed antenna*.

dBf, the hi-fi tuner unit	
0 dBf	1 fW = −120 dBm
across 75 Ω	0.274 µV
across 300 Ω	0.548 µV
Power-based, so dBm = dBf − 120 at either impedance. The µV figure depends on the input: McIntosh quotes 13 dBf as "2.5 µV across 300 ohm or 1.25 µV across 75 ohm" [68][70].	

3. Contour → receive level → margin over the receiver

Contour (rule)	mV/m	dBµV/m	At receiver (assumed antenna)	Margin over receiver	Src
Commercial AM: 1 m whip, h_{eff} 0.5 m · receiver: JVC R-K100 usable sensitivity 300 µV/m = 49.5 dBµV/m [69]					
City grade: daytime 5 mV/m over the community	5	74	2.5 mV (≈ −39)	+24.4 dB	[60]
Primary service, towns ≥ 2,500	2	66	1 mV (≈ −47)	+16.5 dB	[58]
Primary service, towns < 2,500	0.5	54	0.25 mV (≈ −59)	+4.4 dB	[58]
Class A daytime protection (co-channel)	0.1	40	50 µV (≈ −73 dBm-equiv. = HF "S9")	−9.5 dB (below the JVC spec)	[58]
Commercial FM: 98 MHz, half-wave dipole 2.15 dBi · tuner: McIntosh MR500, 50 dB quieting 16.8 dBf mono / 37.3 dBf stereo; usable 13 dBf [68] · conversion [66]					
City grade over principal community	3.16	70	−44.9 dBm · 75 dBf · 1.56 mV/75 Ω	+37.8 dB stereo	[64]
Protected, all other stations	1.0	60	−54.9 dBm · 65 dBf · 0.49 mV/75 Ω	+27.8 dB stereo · +52 dB over "usable"	[63]
Protected, Class B/B1 on ch. 221–300	0.5 / 0.7	54 / 57	−60.9 / −57.9 dBm	+21.8 / +24.8 dB over stereo quieting	[63]
Ham, for contrast: at or near threshold					
HF AM receiver, 10 dB S/N in 6 kHz	–		−101 dBm (2.0 µV)	HF band noise in 6 kHz is ≈ −91 … −116 dBm, so at most HF locations the band noise, not the radio, sets the floor	[30][23] calc
2 m FM handheld, 12 dB SINAD	–		−121.9 dBm (0.18 µV)	no built-in margin: it is a threshold spec	[15]
FT8 decode	–		≈ −140 … −116 dBm (0.02–0.35 µV)	0 dB: it works *at* threshold by design	[33]

Rules count field strength at **F(50,50)** for FM (50% of locations, 50% of the time) and groundwave from the §73.184 curves for AM, so real levels swing with terrain, ground conductivity, building loss and, for AM at night, skywave [59][63]. Tuner quieting figures are bench specs at the antenna terminals. All conversions are calculated from the stated formulas; read them as ±3 dB.

Sources, page 4 (also [15][23][30][33] from pages 1–2)
[57] 47 CFR §73.21, AM station classes: ecfr.gov/current/title-47/section-73.21
[58] 47 CFR §73.182, AM service and protection: ecfr.gov/current/title-47/section-73.182
[59] 47 CFR §73.183 / §73.184, groundwave signals and curves: ecfr.gov/current/title-47/section-73.184
[60] 47 CFR §73.24(i), AM principal-community 5 mV/m: ecfr.gov/current/title-47/section-73.24
[61] 47 CFR §73.14 (AM band 535–1705 kHz) · §73.201 (FM 88–108 MHz): ecfr.gov/current/title-47/section-73.14 · /section-73.201
[62] 47 CFR §73.211, FM class ERP/HAAT: ecfr.gov/current/title-47/section-73.211
[63] 47 CFR §73.215, FM protected contours: ecfr.gov/current/title-47/section-73.215
[64] 47 CFR §73.315, FM city grade 70 dBu: ecfr.gov/current/title-47/section-73.315
[65] 47 CFR §97.313, 1.5 kW PEP: ecfr.gov/current/title-47/section-97.313
[66] ITU-R P.525-5, conversion formulae: itu.int/dms_pubrec/itu-r/rec/p/R-REC-P.525-5-202411-I!!PDF-E.pdf
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[68] McIntosh MR500 owner's manual: berners.ch/McIntosh/Downloads/MR500_own.pdf
[69] JVC R-K100 service manual p. 3: manualslib.com/manual/3684135/Jvc-R-K100.html?page=3
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