

The Regency TR-1 53 Years Later



No finer gift
For CHRISTMAS
than the

Regency

**ALL TRANSISTOR
POCKET RADIO**

(USES NO TUBES)

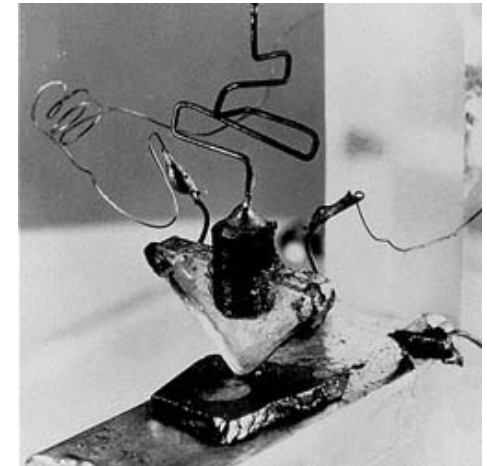
*Enjoy news, sports, music and other entertainment
— anywhere — with the beautifully engineered
REGENCY, WORLD'S SMALLEST STANDARD
RADIO (only 3" x 5" x 1 1/4" — only 12 ounces).*





Key Points

- Introduced October 1954 at \$50 (\$340 in 2004 dollars).
- ~104,000 produced by Industrial Development Engineering Associates (IDEA) in Indianapolis under TI contract.
- 4 Transistors, NPN Ge
- Converter, 2xIF, detector, AF
- 22.5 V battery powered
- Some components borrowed from tube receivers, while others had to be developed.





The Transistors

- Texas Instruments was experimenting with silicon transistors in 1954, but had none in production, so grown-junction germanium transistors were used.
- Early semiconductor processes being what they were, sets of four transistors had to be assembled and used for a particular radio – they weren't interchangeable.



Probable Transistor Specs

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Collector Voltage	-20	volts
Collector Current	-5	ma.
Collector Dissipation (at 30°C)	30	mW.
Emitter Current	5	ma.
Ambient Temperature	50	°C

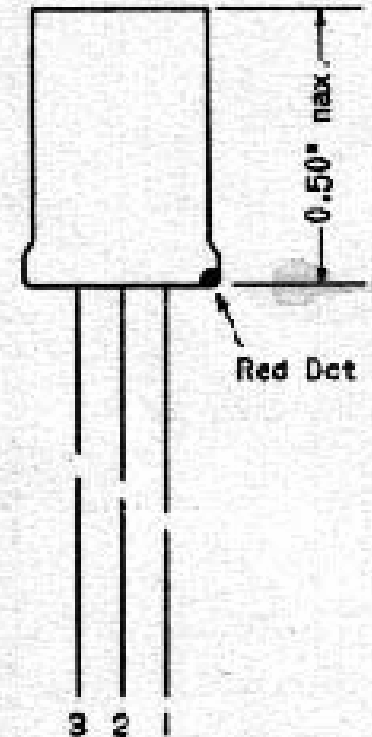
AVERAGE GAIN CHARACTERISTICS - GROUNDING EMITTER: (at 30°C)

Collector Voltage	-1.5	volts
Collector Current	-0.5	ma.
Base Current	20	ua.
Current Amplification Factor	12	
Power Gain*	30	db
Noise Factor # (1000 cycles)	22	db

* Source: 1000 ohms; load: 20,000 ohms

At -1.5 volts (-1.0 ma.) to the collector.

** Socket types: Cinch Wes. 14142 & 14273 or equivalent.



These are specs for the CK-722, a famous PNP grown-junction transistor. Note the complete lack of frequency specs: at that time, α -cutoff was the frequency spec, and 1 MHz was a good value for an RF amplifier.



Why a 22.5 Volt Battery?

- The NEDA 215-style 22.5 volt battery was popular with portable tube equipment.
- The NEDA 1604-style 9 volt battery was developed by Eveready in 1956, two years too late. 215 and 1604 are the same size.
- Also, the transistors had better characteristics, in particular, lower collector-to-base capacitance, when operated at higher voltages.





Electrolytic Capacitors

- Tube circuits tended to use physically larger, lower capacitance, higher voltage capacitors not suitable for the lower-impedance transistor circuits.
- International Electronics in Nashville developed the smaller capacitors with a new electrolytic paste and very thin foil.
- These tended to absorb moisture, and were the nemesis of many TR-1s.



Other New Miniature Parts

- Flat PC-mount volume controls with on/off switch.
- IF transformers and converter coil
- Miniature audio output transformer.
- 1/8" earphone jack
- 2 3/4" speaker
- Flat loopstick antenna



Building the TR-1

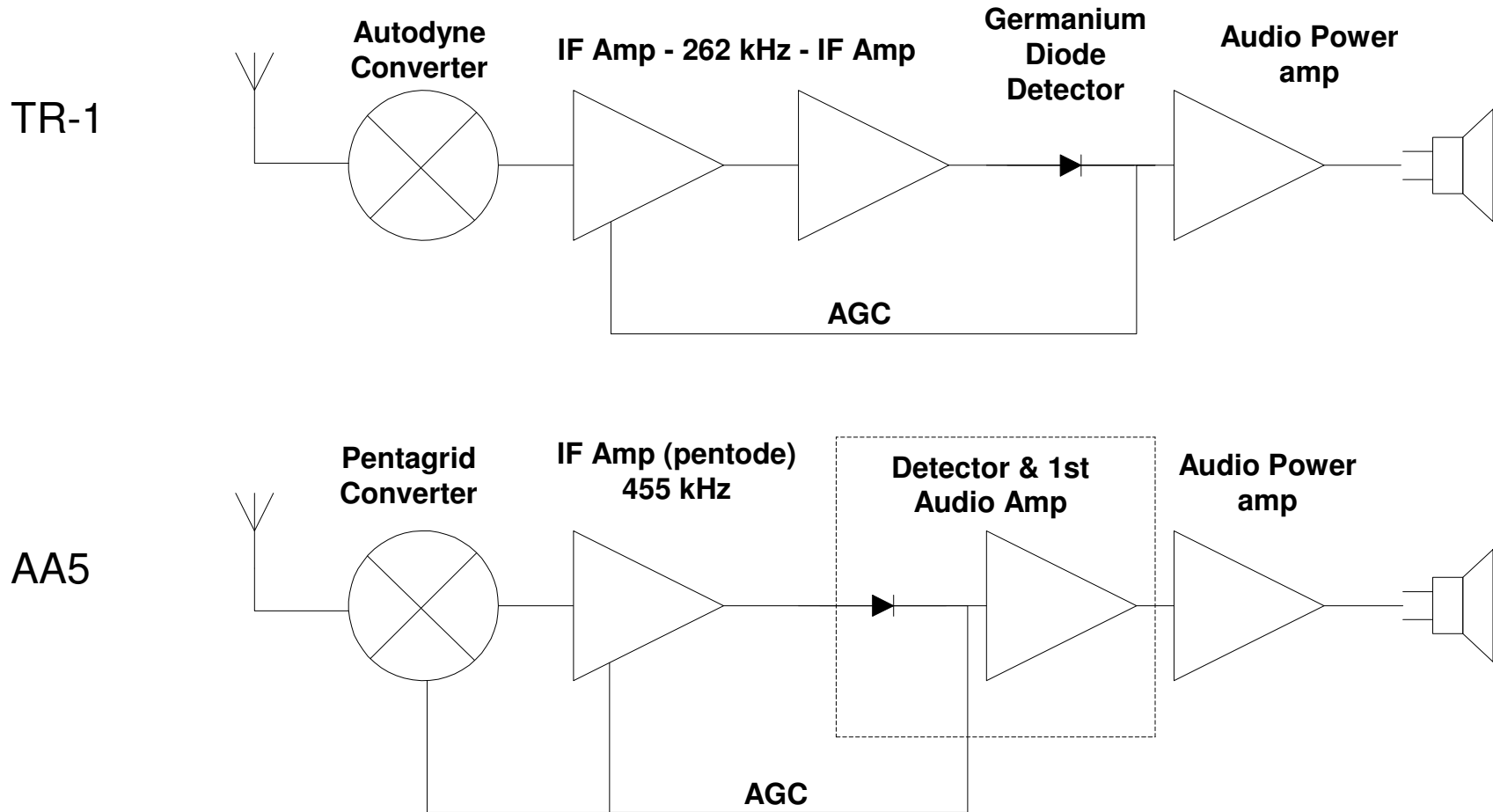
National Museum of
American History

Industry on Parade

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TR-1 & AA5 Block Diagrams





New Design, Good Design?

- Autodyne converters were abandoned for pentagrids in tube radios, but re-emerged. It's as close to a pentagrid as you can get without using dual-gate MOSFETs.
- Pentodes have more gain than a germanium transistor near f_T , hence the need for two IF stages.
- Germanium diode forward breakover introduces more distortion than tube diode.
- AGC range better in remote-cutoff pentode IF amps.



How much gain do we need?

- From FCC AM Broadcast diagrams, at 1 MHz, 1 kW gives ~ 20 mV/m field strength at 10 miles based on a ground wave: this is $2 \mu\text{W}$ in a 50Ω system, or -27 dBm*.
- To develop 100 mW (+20 dBm) audio, need $\text{gain} = 20 \text{ dBm} - (-27 \text{ dBm}) = 47$ dB.
- For skywave propagation at 100 miles, field strength is only $\sim 100 \mu\text{V/m}$, or -72 dBm, so we need $20 \text{ dBm} - (-72 \text{ dBm}) = 92$ dB gain.
- Or, 92 dB gain and $(92 - 47) = 45$ dB AGC range. (A deaf receiver by ham standards!)



Entertainment Hits of 1954

- 1st major commercial color TV broadcast, the Tournament of Roses parade.
- Fender Stratocaster, 1st popular solid-body electric guitar, is released.
- “White Christmas” is first film shot in VistaVision wide-screen format.
- Michael Todd produces “Around the World in 80 Days”, and gives Regency TR-1 radios as mementos to cast members.

BBC WS

Rachel
Rawlins,
2004



Reyer &
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interviews

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