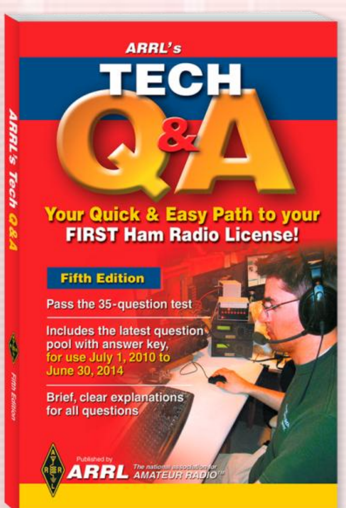
Technician Licensing Class
“T1”



Valid dates:

July 1, 2010 – June 30, 2014

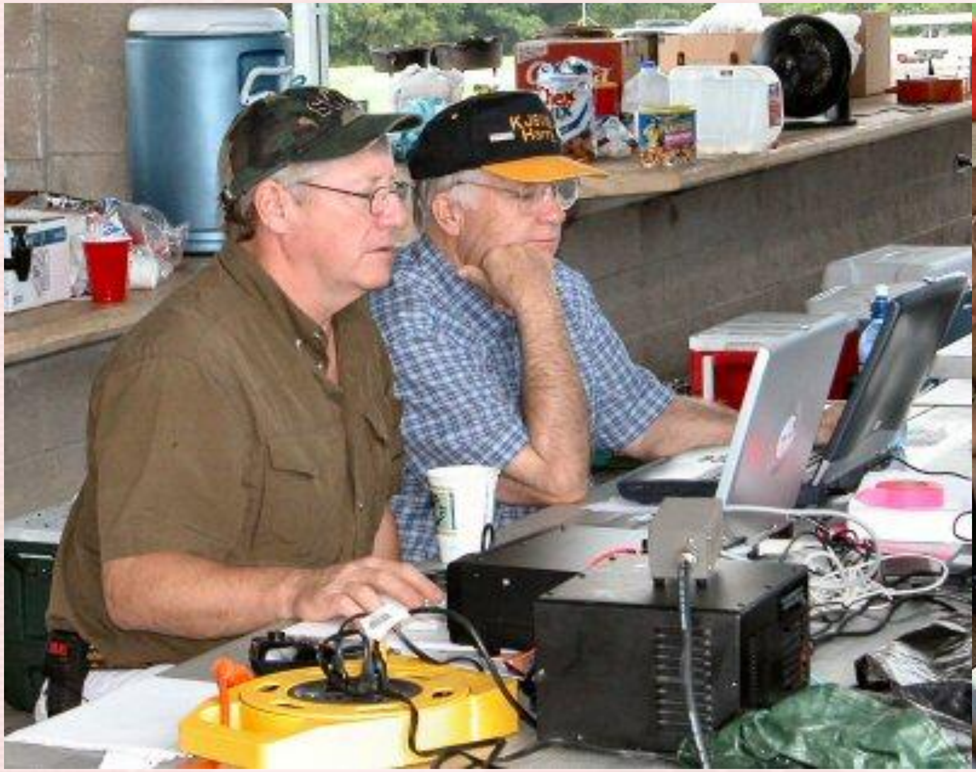
Amateur Radio Technician Class
Element 2 Course Presentation

ELEMENT 2 SUB-ELEMENTS

- **T1 - FCC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities.**
- T2 - Operating Procedures
- T3 - Radio wave characteristics, radio and electromagnetic properties, propagation modes
- T4 - Amateur radio practices and station set up
- T5 - Electrical principles, math for electronics, electronic principles, Ohm's Law
- T6 - Electrical components, semiconductors, circuit diagrams, component functions
- T7 - Station equipment, common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing
- T8 - Modulation modes, amateur satellite operation, operating activities, non-voice communications
- T9 - Antennas, feedlines
- T0 - AC power circuits, antenna installation, RF hazards

T1A: Amateur Radio services; purpose of the amateur service, amateur-satellite service, operator/primary station license grant, where FCC rules are codified, basis and purpose of FCC rules, meanings of basic terms used in FCC rules.

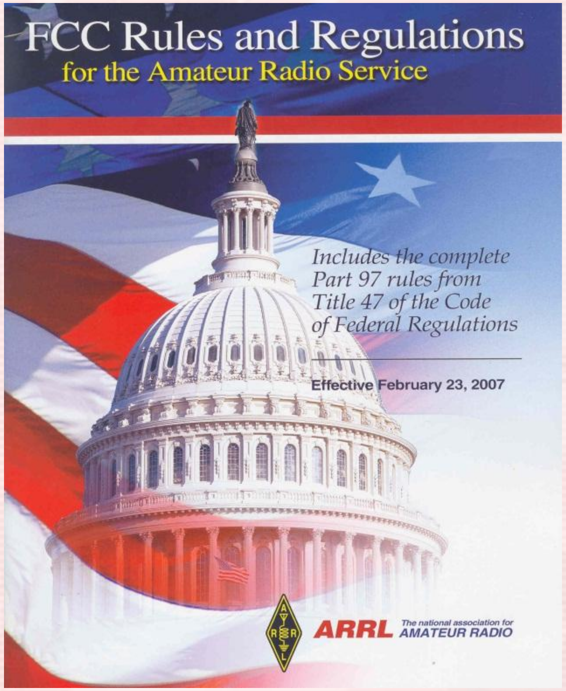
- T1A1 The Amateur Radio Service is intended for persons who are interested in radio technique solely with a personal aim and without pecuniary interest.




There is no minimum age requirement for holding an FCC Amateur Radio License.

T1A: Amateur Radio services; purpose of the amateur service, amateur-satellite service, operator/primary station license grant, where FCC rules are codified, basis and purpose of FCC rules, meanings of basic terms used in FCC rules.

- T1A2 The agency that regulates and enforces the rules for the Amateur Radio Service in the United States is the FCC.
- T1A3 Part 97 of the FCC rules contains the rules and regulations governing the Amateur Radio Service.



FCC governs Amateur Radio Service

Part 97 Amateur Radio regulations are contained in Title-47 Telecommunication. (3 inches thick)

T1A: Amateur Radio services; purpose of the amateur service, amateur-satellite service, operator/primary station license grant, where FCC rules are codified, basis and purpose of FCC rules, meanings of basic terms used in FCC rules.

- T1A4 Any transmission that seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations is defined by the FCC as harmful interference.

- T1A5 An amateur station located more than 50 km above the Earth's surface is considered by FCC Part 97 definition a space station.

- T1A6 The FCC Part 97 definition of ***telecommand*** is a one-way transmission to initiate, modify or terminate functions of a device at a distance.
    - **Types of Commands**
        - Turning ON an amateur radio satellite
        - Initiating a satellite mode change
        - Turning OFF a distant propagation radio beacon
        - Changing data ports on a digital repeater system

T1A: Amateur Radio services; purpose of the amateur service, amateur-satellite service, operator/primary station license grant, where FCC rules are codified, basis and purpose of FCC rules, meanings of basic terms used in FCC rules.

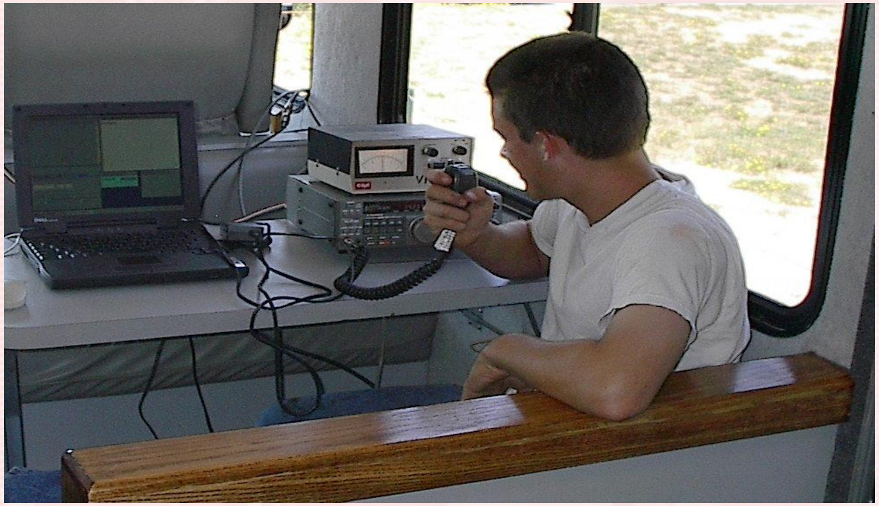
- T1A7 The FCC Part 97 definition of ***telemetry*** is a one-way transmission of measurements at a distance from the measuring instrument.
  - **Type of Information**
    - Battery condition: Full
    - Outside temperature: Very cold
    - Power output: Excellent
    - Solar Panels: Bring on the sun!

- T1A8 A Frequency coordinator recommends transmit/receive channels and other parameters for auxiliary and repeater stations.

- T1A9 Amateur operators in a local or regional area that are eligible to be auxiliary or repeater stations select a frequency coordinator.

T1A: Amateur Radio services; purpose of the amateur service, amateur-satellite service, operator/primary station license grant, where FCC rules are codified, basis and purpose of FCC rules, meanings of basic terms used in FCC rules.

- T1A10 The FCC Part 97 definition of an amateur station is a station in an Amateur Radio Service consisting of the apparatus necessary for carrying on radio communications.



A control operator

Make sure the FCC has issued your call sign before you go on the air for the first time.

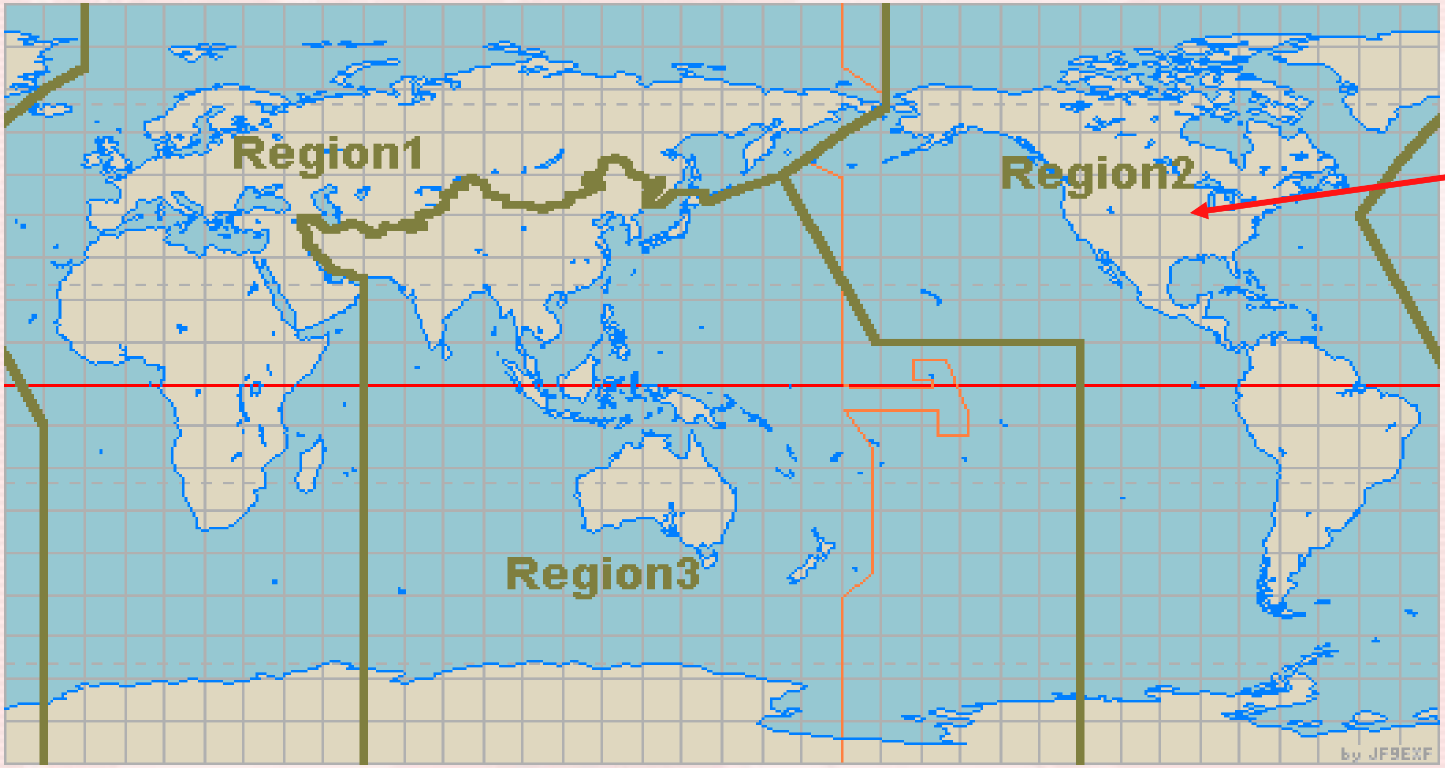
- T1A11 An auxiliary station transmits signals over the air from a remote receive site to a repeater for retransmission.

T1B: Authorized frequencies; frequency allocations, ITU regions, emission type, restricted sub-bands, spectrum sharing, transmissions near band edges.

- T1B1 The ITU (International Telecommunications Union) is a United Nations agency for information and communication technology issues.

T1B: Authorized frequencies; frequency allocations, ITU regions, emission type, restricted sub-bands, spectrum sharing, transmissions near band edges.

- T1B2 North American amateur stations are located in ITU Region 2



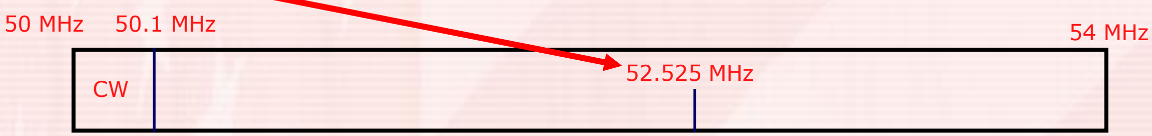
North America

ITU

Region 2

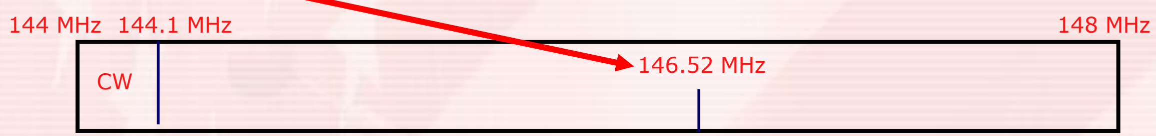
T1B: Authorized frequencies; frequency allocations, ITU regions, emission type, restricted sub-bands, spectrum sharing, transmissions near band edges.

- T1B3 52.525 MHz is a frequency is within the 6 meter band .



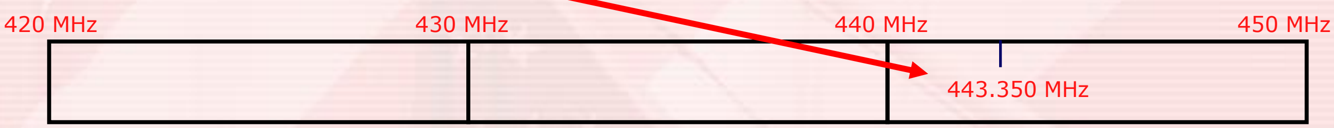
6-Meter Wavelength Band Privileges

- T1B4 146.52 MHz is a frequency is within the 2 meter band.



2-Meter Wavelength Band Privileges

- T1B5 443.350 is a 70 cm frequency authorized to a Technician Class license holder operating in ITU Region 2.
    - 443.350 MHz is in the upper third of the 70 cm band



70-CM Wavelength Band Privileges

T1B: Authorized frequencies; frequency allocations, ITU regions, emission type, restricted sub-bands, spectrum sharing, transmissions near band edges.

- T1B6 A Technician Class operator is authorized to operate on a 23 cm frequency of 1296 MHz.

23-CM Wavelength Band Privileges

- T1B7 Transmitting on 223.500 MHz, you are using the 1.25 meter band.

1.25-Meter Wavelength Band Privileges

- T1B8 When an amateur frequency band is said to be available on a secondary basis, amateurs may not cause harmful interference to primary users.

T1B: Authorized frequencies; frequency allocations, ITU regions, emission type, restricted sub-bands, spectrum sharing, transmissions near band edges.

- T1B9 You should not set your transmit frequency to be exactly at the edge of an amateur band or sub-band:
  - so that modulation sidebands do not extend beyond the band edge;
  - to allow for calibration error in the transmitter frequency display;
  - and to allow for transmitter frequency drift.
- T1B10 The 6 meter, 2 meter, and 1.25 meter bands available to Technician Class operators have mode-restricted sub-bands.

• 6 meters	50.0 – 50.1	No FM!
• 2 meters	144.0 – 144.1	No FM!
• 1.25 meters	222.0 – 222.34	No FM!

- T1B11 In the mode-restricted sub-bands at 50.0 to 50.1 MHz and 144.0 to 144.1 MHz only CW emission modes are permitted.
  - CW only on these two sub-bands

T1C: Operator classes and station call signs; operator classes, sequential, special event, and vanity call sign systems, international communications, reciprocal operation, station license and licensee, places where the amateur service is regulated by the FCC, name and address on ULS, license term, renewal, grace period.

- T1C1 A call sign that has a single letter in both the prefix and suffix is used for a Special Event.
- T1C2 W3ABC is a valid US amateur radio station call sign.

Amateur Radio call sign on license plates.

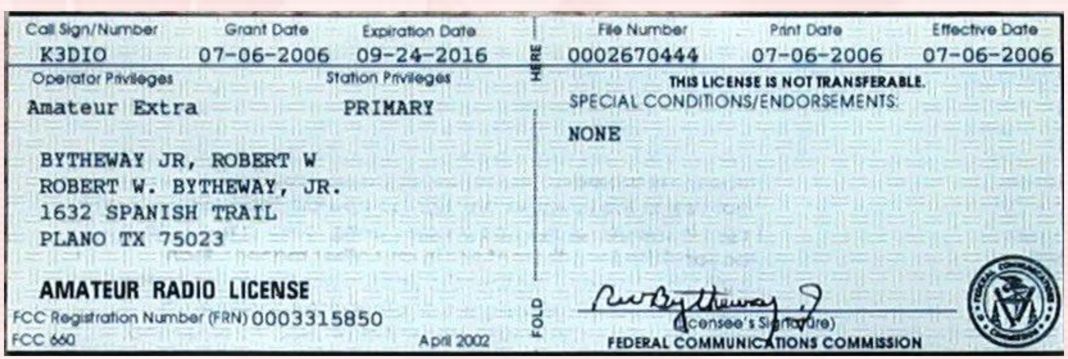
Ham radio call signs, for the U.S, begin with A, K, N, or W. They also have a single numbers 0 through 9.

T1C: Operator classes and station call signs; operator classes, sequential, special event, and vanity call sign systems, international communications, reciprocal operation, station license and licensee, places where the amateur service is regulated by the FCC, name and address on ULS, license term, renewal, grace period.

- T1C3 Communications incidental to the purposes of the amateur service and remarks of a personal character are types of international communications permitted by an FCC-licensed amateur station.
- T1C4 You are allowed to operate your amateur station in a foreign country when the foreign country authorizes it.
- T1C5 If you are operating on the 23 cm band and learn that you are interfering with a radio location station outside the United States you must stop operating or take steps to eliminate the harmful interference.
- T1C6 In addition to places where the FCC regulates communications, an FCC-licensed amateur station can transmit from any vessel or craft operating in international waters that is documented or registered in the United States.

T1C: Operator classes and station call signs; operator classes, sequential, special event, and vanity call sign systems, international communications, reciprocal operation, station license and licensee, places where the amateur service is regulated by the FCC, name and address on ULS, license term, renewal, grace period.

- T1C7 Revocation of the station license or suspension of the operator license may result when correspondence from the FCC is returned as undeliverable because the grantee failed to provide the correct mailing address.
  - **The FCC has suspended two Amateur Radio licenses because the holders had failed to maintain correct mailing addresses in the Commission's licensee database.**
  - Special Counsel in the FCC Spectrum Enforcement Division Riley Hollingsworth wrote **Larry L. Smith, KC7LJR, of Middleton, Idaho, and Larry J. Maniag, KD7JTG, of Payson, Arizona,** on June 28, 2006 to inform them the FCC was suspending their Technician tickets for the remainder of their license terms or until each licensee provides a valid mailing address. http://www.arrl.org/news/stories/2006/07/18/100/
- T1C8 The normal term for an FCC-issued primary station/operator license grant is ten years.



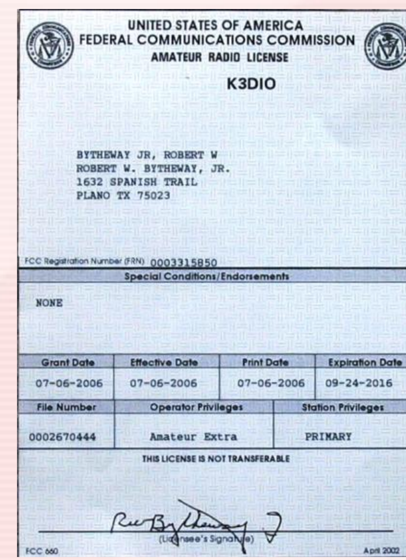
Call Sign/Number	Grant Date	Expiration Date	File Number	Print Date	Effective Date
K3DIO	07-06-2006	09-24-2016	0002670444	07-06-2006	07-06-2006

Operator Privileges: Amateur Extra
Station Privileges: PRIMARY

THIS LICENSE IS NOT TRANSFERABLE.
SPECIAL CONDITIONS/ENDORSEMENTS:
NONE

BYTHEWAY JR, ROBERT W
ROBERT W. BYTHEWAY, JR.
1632 SPANISH TRAIL
PLANO TX 75023

AMATEUR RADIO LICENSE
FCC Registration Number (FRN) 0003315850
FCC 660 April 2002
(Licensee's Signature)
FEDERAL COMMUNICATIONS COMMISSION



UNITED STATES OF AMERICA
FEDERAL COMMUNICATIONS COMMISSION
AMATEUR RADIO LICENSE
K3DIO

BYTHEWAY JR, ROBERT W
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File Number	Operator Privileges	Station Privileges
0002670444	Amateur Extra	PRIMARY

THIS LICENSE IS NOT TRANSFERABLE
(Licensee's Signature)
FCC 660 April 2002

T1C: Operator classes and station call signs; operator classes, sequential, special event, and vanity call sign systems, international communications, reciprocal operation, station license and licensee, places where the amateur service is regulated by the FCC, name and address on ULS, license term, renewal, grace period.

- T1C9 The grace period following the expiration of an amateur license within which the license may be renewed is two years.
- T1C10 You may operate to transmit after you pass the examination elements required for your first amateur radio license as soon as your name and call sign appear in the FCC's ULS database.

- T1C11 If your license has expired and is still within the allowable grace period, you may <u>not</u> continue to operate to transmit until the ULS database shows that the license has been renewed.

T1D: Authorized and prohibited transmissions

- T1D1 FCC-licensed amateur are prohibited from exchanging communications with any country whose administration has notified the ITU that it objects to communications with FCC-licensed amateur stations.
- T1D2 Only during an Armed Forces Day Communications Test may an FCC-licensed amateur station exchange messages with a U.S. military station.
- T1D3 The transmission of codes or ciphers is allowed to hide the meaning of a message transmitted by an amateur station only when transmitting control commands to space stations or radio control craft.

Space station

Radio control craft

T1D: Authorized and prohibited transmissions

- T1D4 The only time an amateur station is authorized to transmit music is when it is incidental to an authorized retransmission of manned spacecraft communications.

Music in the background at your station is not permitted.

- T1D5 Amateur radio operators may use their stations to notify other amateurs of the availability of equipment for sale or trade when the equipment is normally used in an amateur station and such activity is not conducted on a regular basis.

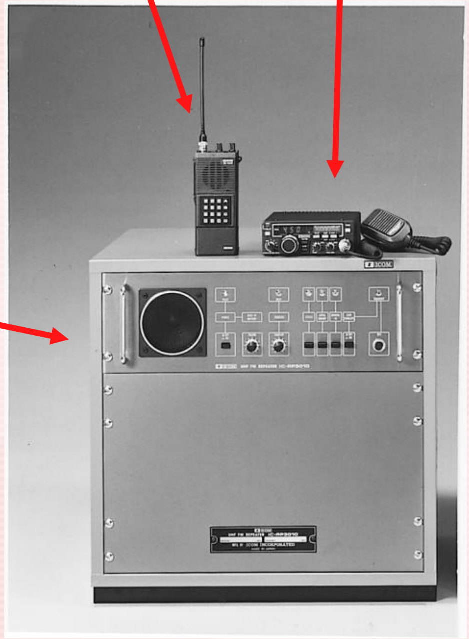
T1D: Authorized and prohibited transmissions

- T1D6 Transmissions that contain obscene or indecent words or language are prohibited.
  - Absolutely not allowed = indecent and obscene language
- T1D7 Amateur station are authorized to automatically retransmit the radio signals of other amateur stations when the signals are from an auxiliary, repeater, or space station.

HandHeld

Mobile/Base Station

Repeater



A repeater: Nice clean, neat, and compact.

T1D: Authorized and prohibited transmissions

What repeaters really look like. Nice neat, clean, and compact.

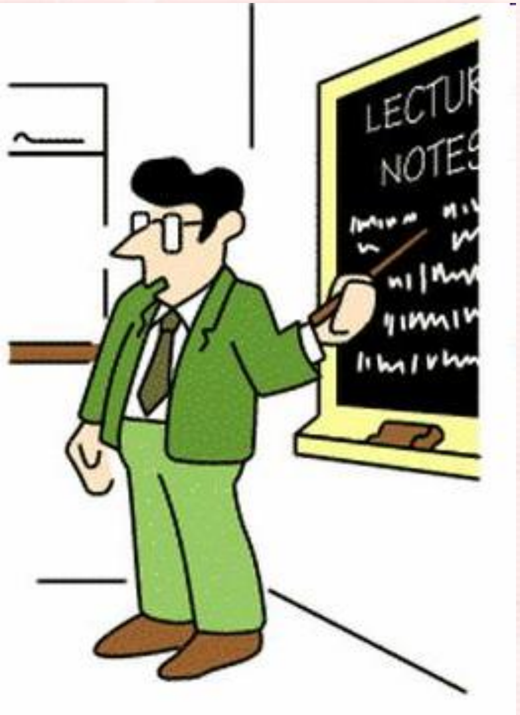
McKinney, Tx 442.575
UHF Repeater

Dallas, Tx 442.025
UHF Repeater

McKinney, Tx 145.350
VHF Repeater

T1D: Authorized and prohibited transmissions

- T1D8 The control operator of an amateur station may receive compensation for operating a station when the communication is incidental to classroom instruction at an educational institution.



School teachers can receive their regular pay when teaching about ham radio

T1D: Authorized and prohibited transmissions

- T1D9 Amateur stations are authorized to transmit signals related to broadcasting, program production, or news gathering, assuming no other means is available only where such communications directly relate to the immediate safety of human life or protection of property.
  - Protecting lives and property

- T1D10 Transmissions intended for reception by the general public is the meaning of the term broadcasting in the FCC rules for the amateur services.

- T1D11 Brief transmissions to make station adjustments is a type of communications permitted in the Amateur Radio Service.

T1E: Control operator and control types; control operator required, eligibility, designation of control operator, privileges and duties, control point, local, automatic and remote control, location of control operator.

- T1E1 An amateur station must have a control operator only when the station is transmitting.

When you operate your station you are the "control operator," and you are at the station's "control point."

- T1E2 Only a person for whom an amateur operator/primary station license grant appears in the FCC database or who is authorized for alien reciprocal operation is eligible to be the control operator of an amateur station.

T1E: Control operator and control types; control operator required, eligibility, designation of control operator, privileges and duties, control point, local, automatic and remote control, location of control operator.

- T1E3 The station licensee must designate the station control operator.
- T1E4 The class of operator license held by the control operator determines the transmitting privileges of an amateur station.

When you operate from another ham's station, you use your license class privileges.

T1E: Control operator and control types; control operator required, eligibility, designation of control operator, privileges and duties, control point, local, automatic and remote control, location of control operator.

- T1E5 The location at which the control operator function is performed is considered the amateur station control point.

The control point is the spot where you have complete capability to turn your equipment on or off.

T1E: Control operator and control types; control operator required, eligibility, designation of control operator, privileges and duties, control point, local, automatic and remote control, location of control operator.

- T1E6 Automatic control is the type of control that is permissible for the control operator to be at a location other than the control point.
- T1E7 The control operator and the station licensee are equally responsible for the proper operation of the station when the control operator is not the station licensee.
  - Both of you are responsible for the transmissions
- T1E8 Automatic control is the type of control being used for a repeater when the control operator is not present at a control point.

T1E: Control operator and control types; control operator required, eligibility, designation of control operator, privileges and duties, control point, local, automatic and remote control, location of control operator.

- T1E9 Local control is the type of control being used when transmitting using a handheld radio.
- T1E10 Remote control is the type of control used when the control operator is not at the station location but can indirectly manipulate the operating adjustments of a station.
- T1E11 The FCC presumes the station licensee to be the control operator of an amateur station unless documentation to the contrary is in the station records.
  - Another licensee runs your gear, log who it was.

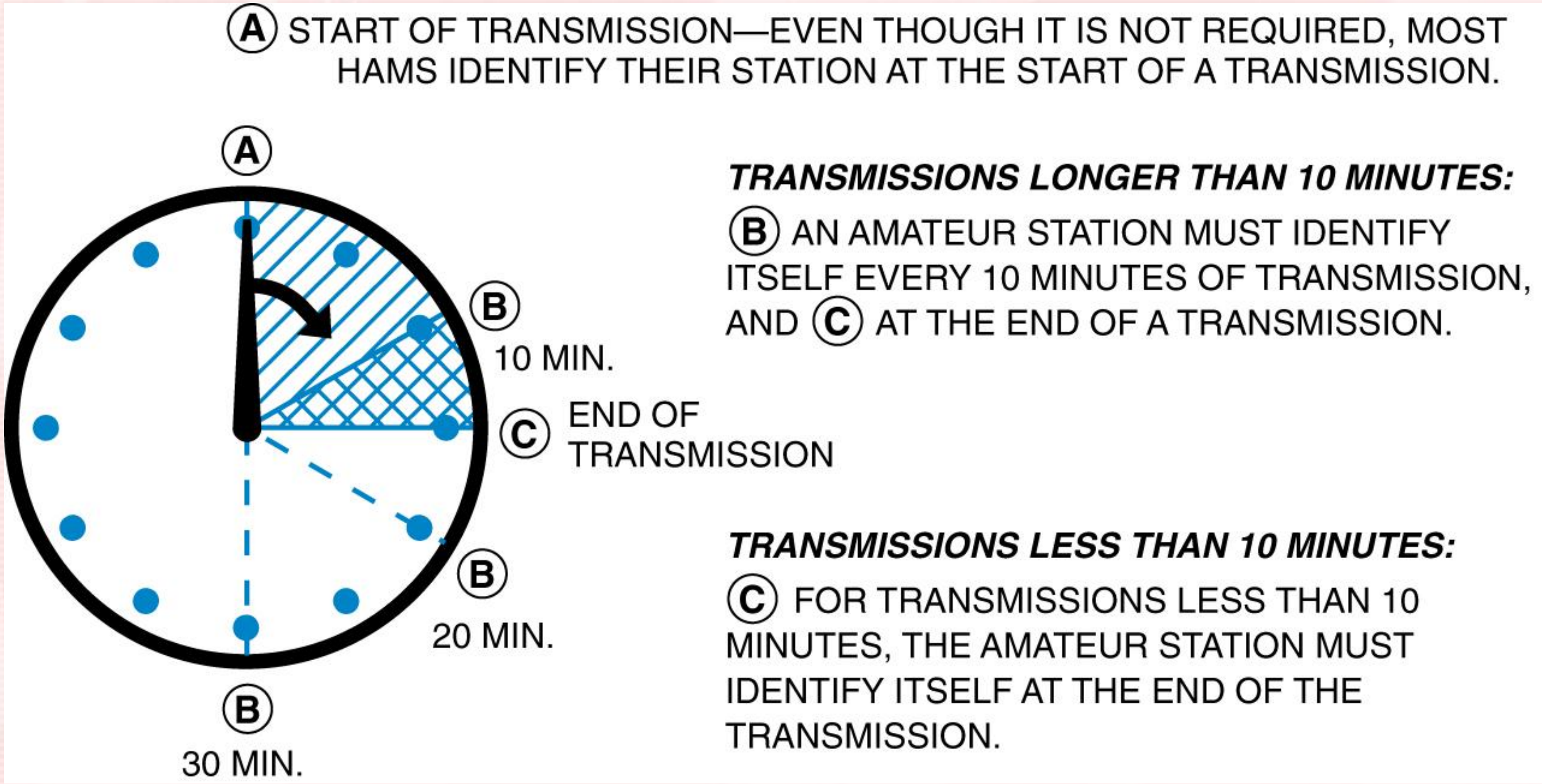
T1F: Station identification and operation standards; special operations for repeaters and auxiliary stations, third party communications, club stations, station security, FCC inspection.

- T1F1 The type of identification being used when identifying a station on the air as “Race Headquarters” is a Tactical call.
  - Tactical call signs ARE permitted as long as they don’t sound like a U.S. or foreign call sign.

- T1F2 When using tactical identifiers you must transmit your station's FCC-assigned call sign every ten minutes.

T1F: Station identification and operation standards; special operations for repeaters and auxiliary stations, third party communications, club stations, station security, FCC inspection.

- T1F03 An amateur station is required to transmit its assigned call sign at least every 10 minutes during and at the end of a contact.



T1F: Station identification and operation standards; special operations for repeaters and auxiliary stations, third party communications, club stations, station security, FCC inspection.

- T1F4 Phone emission in the English language is an acceptable method of station identification when operating in the phone sub-band.

Testing your radio?

Give your call sign in English.

- T1F5 Call sign identification is required for a station transmitting phone signals by sending the call sign using CW or phone emission.

Repeaters can identify with a voice message announcing their call sign, or use Morse code not to exceed 20wpm to send out their station call letters

T1F: Station identification and operation standards; special operations for repeaters and auxiliary stations, third party communications, club stations, station security, FCC inspection.

- T1F6 KL7CC stroke W3, KL7CC slant W3 and KL7CC slash W3 are acceptable formats of self-assigned indicators when identifying using a phone transmission.
  - KL7CC/W3 … Stroke
  - KL7CC/W3 … Slant
  - KL7CC/W3 … Slash
- T1F7 When appending a self-assigned call sign indicator there are restrictions. It must not conflict with any other indicator specified by the FCC rules or with any call sign prefix assigned to another country.
- T1F8 A Technician Class licensee may never be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands.
  - You must stay within your Technician Class band privileges.
- T1F9 A Repeater station is the type of amateur station that simultaneously retransmits the signal of another amateur station on a different channel or channels.

T1F: Station identification and operation standards; special operations for repeaters and auxiliary stations, third party communications, club stations, station security, FCC inspection.

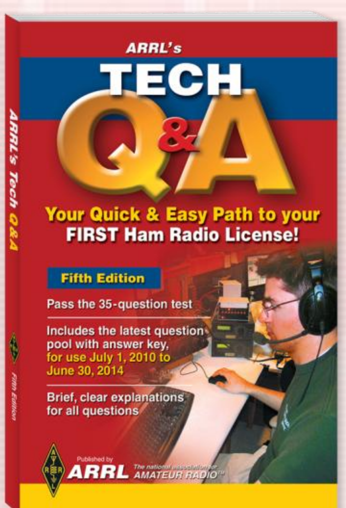
- T1F9 A Repeater station is the type of amateur station that simultaneously retransmits the signal of another amateur station on a different channel or channels.
- T1F10 The control operator of the originating station is accountable should a repeater inadvertently retransmit communications that violate the FCC rules.
- T1F11 FCC rules authorize the transmission of non-emergency third party communications to foreign stations whose government permits such communications
- T1F12 At least 4 persons are required to be members of a club for a club station license to be issued by the FCC.
- T1F13 Any time upon request by an FCC representative is when the station licensee must make the station and its records available for FCC inspection.

Element 2 Technician Class Question Pool

T1

CC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities

[6 Exam Questions – 6 Groups]



Valid July 1, 2010

Through

June 30, 2014

T1A01 For whom is the Amateur Radio Service intended?

A. Persons who have messages to broadcast to the public
B. Persons who need communications for the activities of their immediate family members, relatives and friends
C. Persons who need two-way communications for personal reasons
D. Persons who are interested in radio technique solely with a personal aim and without pecuniary interest

T1A02 What agency regulates and enforces the rules for the Amateur Radio Service in the United States?

A. FEMA
B. The ITU
C. The FCC
D. Homeland Security

T1A03 Which part of the FCC rules contains the rules and regulations governing the Amateur Radio Service?

A. Part 73
B. Part 95
C. Part 90
D. Part 97

T1A04 Which of the following meets the FCC definition of harmful interference?

A. Radio transmissions that annoy users of a repeater

B. Unwanted radio transmissions that cause costly harm to radio station apparatus

C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations

D. Static from lightning storms

T1A05 What is the FCC Part 97 definition of a space station?

A. Any multi-stage satellite
B. An Earth satellite that carries one of more amateur operators
C. An amateur station located less than 25 km above the Earth's surface
D. An amateur station located more than 50 km above the Earth's surface

T1A06 What is the FCC Part 97 definition of telecommand?

A. An instruction bulletin issued by the FCC
B. A one-way radio transmission of measurements at a distance from the measuring instrument
C. A one-way transmission to initiate, modify or terminate functions of a device at a distance
D. An instruction from a VEC

T1A07 What is the FCC Part 97 definition of telemetry?

A. An information bulletin issued by the FCC
B. A one-way transmission to initiate, modify or terminate functions of a device at a distance
C. A one-way transmission of measurements at a distance from the measuring instrument
D. An information bulletin from a VEC Congress of the United States

T1A08 Which of the following entities recommends transmit/receive channels and other parameters for auxiliary and repeater stations?

A. Frequency Spectrum Manager
B. Frequency Coordinator
C. FCC Regional Field Office
D. International Telecommunications Union

T1A09 Who selects a frequency coordinator?

A. The FCC Office of Spectrum Management and Coordination Policy
B. The local chapter of the Office of National Council of Independent Frequency Coordinators
C. Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations
D. Regional field Office

T1A10 What is the FCC Part 97 definition of an amateur station?

A. A station in an Amateur Radio Service consisting of the apparatus necessary for carrying on radio communications
B. A building where Amateur Radio receivers, transmitters, and RF power amplifiers are installed
C. Any radio station operated by a non-professional
D. Any radio station for hobby use

T1A11 Which of the following stations transmits signals over the air from a remote receive site to a repeater for retransmission?

A. Beacon station
B. Relay station
C. Auxiliary station
D. Message forwarding station

T1B01 What is the ITU ?

A. An agency of the United States Department of Telecommunications Management
B. A United Nations agency for information and communication technology issues
C. An independent frequency coordination agency
D. A department of the FCC

T1B02 North American amateur stations are located in which ITU region?

A. Region 1
B. Region 2
C. Region 3
D. Region 4

T1B03 Which frequency is within the 6 meter band?

A. 49.00 MHz
B. 52.525 MHz
C. 28.50 MHz
D. 222.15 MHz

T1B04 Which amateur band are you using when your station is transmitting on 146.52 MHz?

A. 2 meter band
B. 20 meter band
C. 14 meter band
D. 6 meter band

T1B05 Which 70 cm frequency is authorized to a Technician Class license holder operating in ITU Region 2?

A. 53.350 MHz
B. 146.520 MHz
C. 443.350 MHz
D. 222.520 MHz

T1B06 Which 23 cm frequency is authorized to a Technician Class operator license?

A. 2315 MHz
B. 1296 MHz
C. 3390 MHz
D. 146.52 MHz

T1B07 What amateur band are you using if you are transmitting on 223.50 MHz?

A. 15 meter band
B. 10 meter band
C. 2 meter band
D. 1.25 meter band

T1B08 What do the FCC rules mean when an amateur frequency band is said to be available on a secondary basis?

A. Secondary users of a frequency have equal rights to operate
B. Amateurs are only allowed to use the frequency at night
C. Amateurs may not cause harmful interference to primary users
D. Secondary users are not allowed on amateur bands

T1B09 Why should you not set your transmit frequency to be exactly at the edge of an amateur band or sub-band?

A. To allow for calibration error in the transmitter frequency display
B. So that modulation sidebands do not extend beyond the band edge
C. To allow for transmitter frequency drift
D. All of these choices are correct

T1B10 Which of the bands available to Technician Class operators have mode-restricted sub-bands?

A. The 6 meter, 2 meter, and 70 cm bands
B. The 2 meter and 13 cm bands
C. The 6 meter, 2 meter, and 1.25 meter bands
D. The 2 meter and 70 cm bands

T1B11 What emission modes are permitted in the mode-restricted sub-bands at 50.0 to 50.1 MHz and 144.0 to 144.1 MHz?

A. CW only
B. CW and RTTY
C. SSB only
D. CW and SSB

T1C01 Which type of call sign has a single letter in both the prefix and suffix?

A. Vanity
B. Sequential
C. Special event
D. In-memoriam

T1C02 Which of the following is a valid US amateur radio station call sign?

A. KMA3503
B. W3ABC
C. KDKA
D. 11Q1176

T1C03 What types of international communications are permitted by an FCC-licensed amateur station?

A. Communications incidental to the purposes of the amateur service and remarks of a personal character
B. Communications incidental to conducting business or remarks of a personal nature
C. Only communications incidental to contest exchanges, all other communications are prohibited
D. Any communications that would be permitted on an international broadcast station

T1C04 When are you allowed to operate your amateur station in a foreign country?

A. When the foreign country authorizes it
B. When there is a mutual agreement allowing third party communications
C. When authorization permits amateur communications in a foreign language
D. When you are communicating with non-licensed individuals in another country

T1C05 What must you do if you are operating on the 23 cm band and learn that you are interfering with a radiolocation station outside the US?

A. Stop operating or take steps to eliminate the harmful interference

B. Nothing, because this band is allocated exclusively to the amateur service

C. Establish contact with the radiolocation station and ask them to change frequency

D. Change to CW mode, because this would not likely cause interference

T1C06 From which of the following may an FCC-licensed amateur station transmit, in addition to places where the FCC regulates communications?

A. From within any country that belongs to the International Telecommunications Union
B. From within any country that is a member of the United Nations
C. From anywhere within in ITU Regions 2 and 3
D. From any vessel or craft located in international waters and documented or registered in the United States

T1C07 What may result when correspondence from the FCC is returned as undeliverable because the grantee failed to provide the correct mailing address?

A. Fine or imprisonment
B. Revocation of the station license or suspension of the operator license
C. Require the licensee to be re-examined
D. A reduction of one rank in operator class

T1C08 What is the normal term for an FCC-issued primary station/operator license grant?

A. Five years
B. Life
C. Ten years
D. Twenty years

T1C09 What is the grace period following the expiration of an amateur license within which the license may be renewed?

A. Two years
B. Three years
C. Five years
D. Ten years

T1C10

How soon may you operate a transmitter on an amateur service frequency after you pass the examination required for your first amateur radio license?

A. Immediately
B. 30 days after the test date
C. As soon as your name and call sign appear in the FCC's ULS database
D. You must wait until you receive your license in the mail from the FCC.

T1C11 If your license has expired and is still within the allowable grace period, may you continue to operate a transmitter on amateur radio frequencies?

A. No, transmitting is not allowed until the ULS database shows that the license has been renewed
B. Yes, but only if you identify using the suffix "GP"
C. Yes, but only during authorized nets
D. Yes, for up to two years

T1D01 With which countries are FCC-licensed amateur stations prohibited from exchanging communications?

A. Any country whose administration has notified the ITU that it objects to such communications
B. B. Any country whose administration has notified the United Nations that it objects to such communications
C. C. Any country engaged in hostilities with another country
D. D. Any country in violation of the War Powers Act of 1934

T1D02 On which of the following occasions may an FCC-licensed amateur station exchange messages with a U.S. military station?

A. During an Armed Forces Day Communications Test
B. During a Memorial Day Celebration
C. During an Independence Day celebration
D. During a propagation test

T1D03 When is the transmission of codes or ciphers allowed to hide the meaning of a message transmitted by an amateur station?

A. Only during contests
B. Only when operating mobile
C. Only when transmitting control commands to space stations or radio control craft
D. Only when frequencies above 1280 MHz are used

T1D04 What is the only time an amateur station is authorized to transmit music?

A. When incidental to an authorized retransmission of manned spacecraft communications
B. B. When the music produces no spurious emissions
C. C. When the purpose is to interfere with an illegal transmission
D. D. When the music is transmitted above 1280 MHz

T1D05 When may amateur radio operators use their stations to notify other amateurs of the availability of equipment for sale or trade?

A. When the equipment is normally used in an amateur station and such activity is not conducted on a regular basis
B. B. When the asking price is $100.00 or less
C. C. When the asking price is less than its appraised value
D. D. When the equipment is not the personal property of either the station licensee or the control operator or their close relatives

T1D06 Which of the following types of transmissions are prohibited?

A. Transmissions that contain obscene or indecent words or language

B. B. Transmissions to establish one-way communications

C. C. Transmissions to establish model aircraft control

D. D. Transmissions for third party communications

T1D07 When is an amateur station authorized to automatically retransmit the radio signals of other amateur stations?

A. When the signals are from an auxiliary, beacon, or Earth station
B. When the signals are from an auxiliary, repeater, or space station
C. When the signals are from a beacon, repeater, or space station
D. When the signals are from an Earth, repeater, or space station

T1D08 When may the control operator of an amateur station receive compensation for operating the station?

A. When engaging in communications on behalf of their employer
B. When the communication is incidental to classroom instruction at an educational institution
C. When re-broadcasting weather alerts during a RACES net
D. When notifying other amateur operators of the availability for sale or trade of apparatus

T1D09 Under which of the following circumstances are amateur stations authorized to transmit signals related to broadcasting, program production, or news gathering, assuming no other means is available?

A. Only where such communications directly relate to the immediate safety of human life or protection of property

B. Only when broadcasting communications to or from the space shuttle.

C. Only where noncommercial programming is gathered and supplied exclusively to the National Public Radio network

D. Only when using amateur repeaters linked to the Internet

T1D10 What is the meaning of the term broad-casting in the FCC rules for the amateur services?

A. Two-way transmissions by amateur stations
B. Transmission of music
C. Transmission of messages directed only to amateur operators
D. Transmissions intended for reception by the general public

T1D11 Which of the following types of communications are permitted in the Amateur Radio Service?

A. Brief transmissions to make station adjustments

B. Retransmission of entertainment programming from a commercial radio or TV station

C. Retransmission of entertainment material from a public radio or TV station

D. Communications on a regular basis that could reasonably be furnished alternatively through other radio services

T1E01 When must an amateur station have a control operator?

A. Only when the station is transmitting
B. Only when the station is being locally controlled
C. Only when the station is being remotely controlled
D. Only when the station is being automatically controlled

T1E02 Who is eligible to be the control operator of an amateur station?

A. Only a person holding an amateur service license from any country that belongs to the United Nations
B. Only a citizen of the United States
C. Only a person over the age of 18
D. Only a person for whom an amateur operator/primary station license grant appears in the FCC database or who is authorized for alien reciprocal operation

T1E03 Who must designate the station control operator?

A. The station licensee
B. The FCC
C. The frequency coordinator
D. The ITU

T1E04 What determines the transmitting privileges of an amateur station?

A. The frequency authorized by the frequency coordinator
B. The class of operator license held by the station licensee
C. The highest class of operator license held by anyone on the premises
D. The class of operator license held by the control operator

T1E05 What is an amateur station control point?

A. The location of the station's transmitting antenna
B. The location of the station transmitting apparatus.
C. The location at which the control operator function is performed
D. The mailing address of the station licensee

T1E06 Under which of the following types of control is it permissible for the control operator to be at a location other than the control point?

A. Local control
B. Automatic control
C. Remote control
D. Indirect control

T1E07 When the control operator is not the station licensee, who is responsible for the proper operation of the station?

A. All licensed amateurs who are present at the operation
B. Only the station licensee
C. Only the control operator
D. The control operator and the station licensee are equally responsible

T1E08 What type of control is being used for a repeater when the control operator is not present at a control point?

A. Local control
B. Remote control
C. Automatic control
D. Unattended

T1E09 What type of control is being used when transmitting using a handheld radio?

A. Radio control
B. Unattended control
C. Automatic control
D. Local control

T1E10 What type of control is used when the control operator is not at the station location but can indirectly manipulate the operating adjustments of a station?

A. Local
B. Remote
C. Automatic
D. Unattended

T1E11 Who does the FCC presume to be the control operator of an amateur station, unless documentation to the contrary is in the station records?

A. The station custodian
B. The third party participant
C. The person operating the station equipment
D. The station licensee

T1F01 What type of identification is being used when identifying a station on the air as "Race Headquarters"?

A. Tactical call
B. Self-assigned designator
C. SSID
D. Broadcast station

T1F02 When using tactical identifiers, how often must your station transmit the station's FCC-assigned call sign?

A. Never, the tactical call is sufficient
B. Once during every hour
C. Every ten minutes
D. At the end of every communication

T1F03 When is an amateur station required to transmit its assigned call sign?

A. At the beginning of each contact, and every 10 minutes thereafter
B. At least once during each transmission
C. At least every 15 minutes during and at the end of a contact
D. At least every 10 minutes during and at the end of a contact

T1F04 Which of the following is an acceptable method of station identification when operating in the phone sub-band?

A. Any language recognized by the United Nations
B. Any language recognized by the ITU
C. The English language
D. English, French, or Spanish

T1F05 What method of call sign identification is required for a station transmitting phone signals?

A. Send the call sign followed by the indicator RPT
B. Send the call sign using CW or phone emission
C. Send the call sign followed by the indicator R
D. Send the call sign using only phone emission

T1F06 Which of the following formats of a self-assigned indicator is acceptable when identifying using a phone transmission?

A. KL7CC stroke W3
B. KL7CC slant W3
C. KL7CC slash W3
D. All of these choices are correct

T1F07 Which of the following restrictions apply when appending a self-assigned call sign indicator?

A. It must be more than three letters and less than five letters
B. It must be less than five letters
C. It must start with the letters AA through AL, K, N, or W and be not less than two characters or more than five characters in length
D. It must not conflict with any other indicator specified by the FCC rules or with any call sign prefix assigned to another country

T1F08

When may a Technician Class licensee be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands?

A. Never
B. On Armed Forces Day
C. As part of a multi-operator contest team
D. When using a club station whose trustee is an Extra Class operator licensee

T1F09 What type of amateur station simultaneously retransmits the signal of another amateur station on a different channel or channels?

A. Beacon station
B. Earth station
C. Repeater station
D. Message forwarding station

T1F10 Who is accountable should a repeater inadvertently retransmit communications that violate the FCC rules?

A. The control operator of the originating station
B. The control operator of the repeater
C. The owner of the repeater
D. Both the originating station and the repeater owner

T1F11 To which foreign stations do the FCC rules authorize the transmission of non-emergency third party communications?

A. Any station whose government permits such communications
B. Those in ITU Region 2 only
C. Those in ITU Regions 2 and 3 only
D. Those in ITU Region 3 only

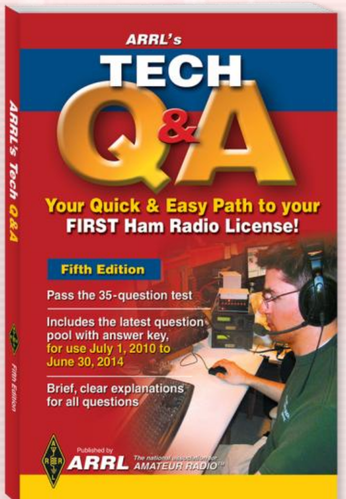
T1F12 How many persons are required to be members of a club for a club station license to be issued by the FCC?

A. At least 5
B. At least 4
C. A trustee and 2 officers
D. At least 2

T1F13 When must the station licensee make the station and its records available for FCC inspection?

A. Any time upon request by an official observer
B. Any time upon request by an FCC representative
C. 30 days prior to renewal of the station license
D. 10 days before the first transmission

Technician Licensing Class
“T2”



Valid dates:

July 1, 2010 – June 30, 2014

ELEMENT 2 SUB-ELEMENTS

- T1 - FCC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities.
- **T2 – Operating Procedures**
- T3 – Radio wave characteristics, radio and electromagnetic properties, propagation modes
- T4 – Amateur radio practices and station set up
- T5 – Electrical principles, math for electronics, electronic principles, Ohm's Law
- T6 – Electrical components, semiconductors, circuit diagrams, component functions
- T7 – Station equipment, common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing
- T8 – Modulation modes, amateur satellite operation, operating activities, non-voice communications
- T9 – Antennas, feedlines
- T0 – AC power circuits, antenna installation, RF hazards

T2A: Station operation; choosing an operating frequency, calling another station, test transmissions, use of minimum power, frequency use, band plans.

- T2A1 The most common repeater frequency offset in the 2 meter band is plus or minus 600 kHz.
- T2A2 The national calling frequency is 446.000 MHz for FM simplex operation on the 70 cm band.
- T2A3 Plus or minus 5 MHz is a common repeater frequency offset in the 70 cm band.
- T2A4 An appropriate way to call another station on a repeater if you know the other station's call sign is to say the station's call sign then identify with your call sign.
    - W2HLD this is K3DIO
- T2A5 When responding to a call of CQ you should transmit the other station's call sign followed by your call sign.
    - W5YI this is K3DIO

T2A: Station operation; choosing an operating frequency, calling another station, test transmissions, use of minimum power, frequency use, band plans.

- T2A6 When making on-air transmissions to test equipment or antennas an amateur operator must properly identify the transmitting station.
  - All transmissions must be identified
- T2A7 When making a test transmission a station identification is required at least every ten minutes during the test and at the end.
  - Just like normal ID requirements for a QSO
- T2A8 The procedural signal "CQ" means calling any station.
- T2A9 A brief statement of saying your call sign is often used in place of "CQ" to indicate that you are listening on a repeater.
- T2A10 A band plan, beyond the privileges established by the FCC, is a voluntary guideline for using different modes or activities within an amateur band.

T2A: Station operation; choosing an operating frequency, calling another station, test transmissions, use of minimum power, frequency use, band plans.

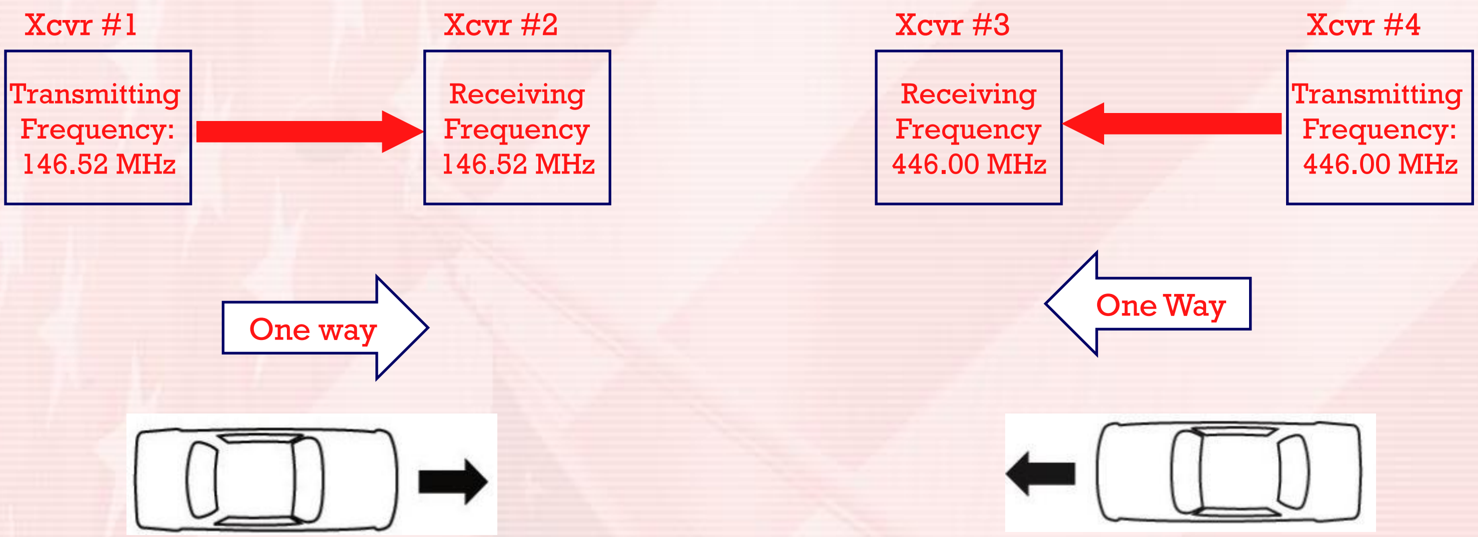
- T2A11 FCC rules regarding power levels used in the amateur bands state that an amateur must use the minimum transmitter power necessary to carry out the desired communication.

Amateur accepted simplex frequencies

Use the minimum amount of power output to make contact with another station

T2B: VHF/UHF operating practices; SSB phone, FM repeater, simplex, frequency offsets, splits and shifts, CTCSS, DTMF, tone squelch, carrier squelch, phonetics.

- T2B1 Simplex communication is the term used to describe an amateur station that is transmitting and receiving on the same frequency.



- No offset frequency used for simplex like with a repeater

T2B: VHF/UHF operating practices; SSB phone, FM repeater, simplex, frequency offsets, splits and shifts, CTCSS, DTMF, tone squelch, carrier squelch, phonetics.

- T2B2 CTCSS is the term used to describe the use of a sub-audible tone transmitted with normal voice audio to open the squelch of a receiver (CTCSS – **C**ontinuous **T**one-**C**oded **S**quelch **S**ystem)
  - Also called a PL tone.

CTCSS Tones In Use

67.0 Hz	94.8 Hz	131.8 Hz	171.3 Hz	203.5 Hz
69.3 Hz	97.4 Hz	136.5 Hz	173.8 Hz	206.5 Hz
71.9 Hz	100.0 Hz	141.3 Hz	177.3 Hz	210.7 Hz
74.4 Hz	103.5 Hz	146.2 Hz	179.9 Hz	218.1 Hz
77.0 Hz	107.2 Hz	151.4 Hz	183.5 Hz	225.7 Hz
79.7 Hz	110.9 Hz	156.7 Hz	186.2 Hz	229.1 Hz
82.5 Hz	114.8 Hz	159.8 Hz	189.9 Hz	233.6 Hz
85.4 Hz	118.8 Hz	162.2 Hz	192.8 Hz	241.8 Hz
88.5 Hz	123.0 Hz	165.5 Hz	196.6 Hz	250.3 Hz
91.5 Hz	127.3 Hz	167.9 Hz	199.5 Hz	254.1 Hz

T2B: VHF/UHF operating practices; SSB phone, FM repeater, simplex, frequency offsets, splits and shifts, CTCSS, DTMF, tone squelch, carrier squelch, phonetics.

- T2B3 Carrier squelch describes the muting of receiver audio controlled solely by the presence or absence of an RF signal.

- T2B4 Common problems that cause you to be able to hear but not access a repeater even when transmitting with the proper offset:

  - The repeater receiver requires audio burst for access

  - The repeater receiver requires a CTCSS tone for access
    - CTCSS – **C**ontinuous **T**one **C**ontrol **S**quelch **S**ystem

  - The repeater receiver may require a DCS tone sequence for access
    - DCS – **D**igital **C**ode **S**quelch

T2B: VHF/UHF operating practices; SSB phone, FM repeater, simplex, frequency offsets, splits and shifts, CTCSS, DTMF, tone squelch, carrier squelch, phonetics.

- T2B5 The amplitude of the modulating signal determines the amount of deviation of an FM signal.

- T2B6 When the deviation of an FM transmitter is increased its signal occupies more bandwidth.

- T2B7 If you receive a report that your station's transmissions are causing splatter or interference on nearby frequencies check your transmitter for off-frequency operation or spurious emissions.

- T2B8 The proper course of action to take if your station's transmission unintentionally interferes with another station is to properly identify your transmission and move to a different frequency.

- T2B9 Use of a phonetic alphabet is the method encouraged by the FCC when identifying your station when using phone.

A Alpha	H Hotel	O Oscar	V Victor
B Bravo	I India	P Papa	W Whiskey
C Charlie	J Juliet	Q Quebec	X X-ray
D Delta	K Kilo	R Romeo	Y Yankee
E Echo	L Lima	S Sierra	Z Zulu
F Foxtrot	M Mike	T Tango	
G Golf	N November	U Uniform	

- T2B10 QRM is the "Q" signal used to indicate that you are receiving interference from other stations.
- T2B11 QSY is the "Q" signal used to indicate that you are changing frequency.

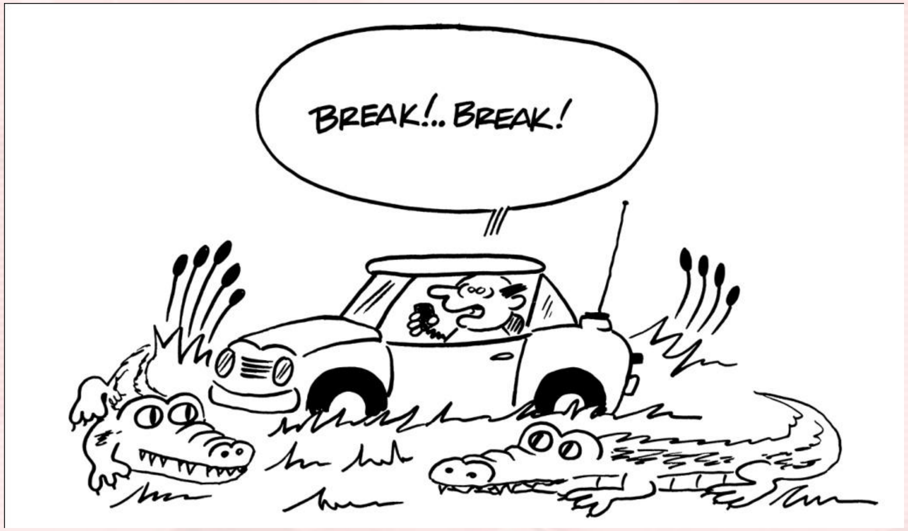
QRM	**Something is causing interference**
QRN	I am troubled by static/noise.
QRP	I am running low power.
QRT	I am going off the air.
QRZ	Who is calling me?
QSB	Your signal is fading.
QSL	I received the message.
QSO	I will communicate with _________ directly.
QSY	**I am changing frequency to _____.**
QTH	My location is ________.

T2C: Public service; emergency and non-emergency operations, message traffic handling

- T2C1 FCC rules apply to proper operation of your station when using amateur radio at the request of public service officials.
    - Amateur radio operators are not relieved from FCC rules at request from FBI, FEMA, or any other Federal agency.
- T2C4 Both RACES (Radio Amateur Civil Emergency Service) and ARES (Amateur Radio Emergency Service) organizations may provide communications during emergencies.
- T2C5 Radio Amateur Civil Emergency Service (RACES) is a radio service using amateur stations for emergency management or civil defense communications.

T2C: Public service; emergency and non-emergency operations, message traffic handling

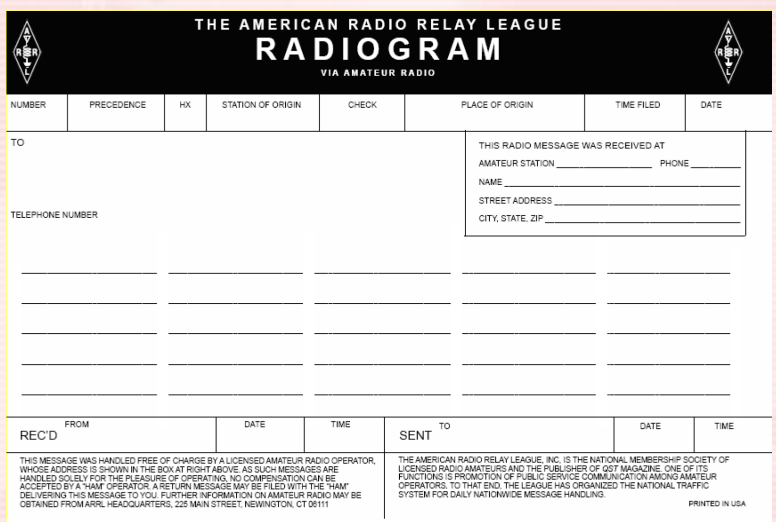
- T2C6 Common practice during net operations to get the immediate attention of the net control station when reporting an emergency is to begin your transmission with "Priority" or "Emergency" followed by your call sign.



Another way to interrupt a conversation to signal a distress call is to say the word "BREAK" several times to indicate a priority or emergency distress call.

T2C: Public service; emergency and non-emergency operations, message traffic handling

- T2C7 In order to minimize disruptions to an emergency traffic net once you have checked in, do not transmit on the net frequency until asked to do so by the net control station.
- T2C8 Passing messages exactly as written, spoken or as received is usually considered to be the most important job of an amateur operator when handling emergency traffic messages.
  - Write in block letters, word for word.


THE AMERICAN RADIO RELAY LEAGUE
RADIOGRAM
VIA AMATEUR RADIO

NUMBER	PRECEDENCE	HX	STATION OF ORIGIN	CHECK	PLACE OF ORIGIN	TIME FILED	DATE

TO

TELEPHONE NUMBER

THIS RADIO MESSAGE WAS RECEIVED AT
AMATEUR STATION ______________ PHONE ______
NAME ______________________________
STREET ADDRESS ______________________________
CITY, STATE, ZIP ______________________________

REC'D FROM	DATE	TIME	SENT TO	DATE	TIME

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T2C: Public service; emergency and non-emergency operations, message traffic handling

- T2C9 When normal communications systems are not available, an amateur station may use any means of radio communications at its disposal for essential communications in connection with immediate safety of human life and protection of property.
    - in an *emergency, anything goes!*

T2C: Public service; emergency and non-emergency operations, message traffic handling

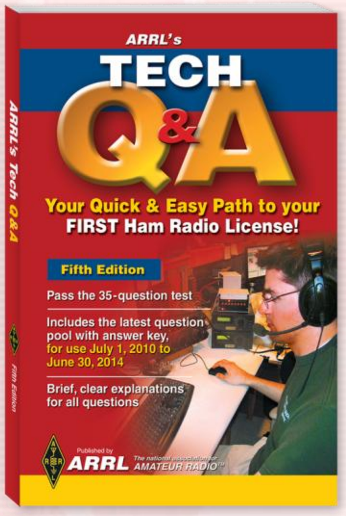
- T2C10 In a formal traffic message the information needed to track the message as it passes through the amateur radio traffic handling system is called the preamble.
    - Keep track of emergency messages as they pass through the well structured amateur radio traffic-handling system.
- T2C11 The term "check" in reference to a formal traffic message is a count of the number of words or word equivalents in the text portion of the message.
    - include a ‘check’ to make sure **all words in a message** indeed were received in their entirety.

Element 2 Technician Class Question Pool

T2

Operating Procedures

[3 Exam Questions – 3 Groups]



Valid July 1, 2010

Through

June 30, 2014

T2A01 What is the most common repeater frequency offset in the 2 meter band?

A. Plus 500 kHz
B. Plus or minus 600 kHz
C. Minus 500 kHz
D. Only plus 600 kHz

T2A02 What is the national calling frequency for FM simplex operations in the 70 cm band?

A. 146.520 MHz
B. 145.000 MHz
C. 432.100 MHz
D. 446.000 MHz

T2A03 What is a common repeater frequency offset in the 70 cm band?

A. Plus or minus 5 MHz
B. Plus or minus 600 kHz
C. Minus 600 kHz
D. Plus 600 kHz

T2A04 What is an appropriate way to call another station on a repeater if you know the other station's call sign?

A. Say "break, break" then say the station's call sign
B. Say the station's call sign then identify with your call sign
C. Say "CQ" three times then the other station's call sign
D. Wait for the station to call "CQ" then answer it

T2A05 What should you transmit when responding to a call of CQ?

A. CQ followed by the other station's call sign

B. Your call sign followed by the other station's call sign

C. The other station's call sign followed by your call sign

D. A signal report followed by your call sign

T2A06 What must an amateur operator do when making on-air transmissions to test equipment or antennas?

A. Properly identify the transmitting station
B. Make test transmissions only after 10:00 p.m. local time
C. Notify the FCC of the test transmission
D. State the purpose of the test during the test procedure

T2A07 Which of the following is true when making a test transmission?

A. Station identification is not required if the transmission is less than 15 seconds

B. Station identification is not required if the transmission is less than 1 watt

C. Station identification is required only if your station can be heard

D. Station identification is required at least every ten minutes during the test and at the end

T2A08 What is the meaning of the procedural signal "CQ"?

A. Call on the quarter hour
B. A new antenna is being tested (no station should answer)
C. Only the called station should transmit
D. Calling any station

T2A09 What brief statement is often used in place of "CQ" to indicate that you are listening on a repeater?

A. Say "Hello test" followed by your call sign
B. Say your call sign
C. Say the repeater call sign followed by your call sign
D. Say the letters "QSY" followed by your call sign

T2A10 What is a band plan, beyond the privileges established by the FCC?

A. A voluntary guideline for using different modes or activities within an amateur band
B. A mandated list of operating schedules
C. A list of scheduled net frequencies
D. A plan devised by a club to use a frequency band during a contest

T2A11 What are the FCC rules regarding power levels used in the amateur bands?

A. Always use the maximum power allowed to ensure that you complete the contact

B. An amateur may use no more than 200 watts PEP to make an amateur contact

C. An amateur may use up to 1500 watts PEP on any amateur frequency

D. An amateur must use the minimum transmitter power necessary to carry out the desired communication

T2B01 What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?

A. Full duplex communication
B. Diplex communication
C. Simplex communication
D. Half duplex communication

T2B02 What is the term used to describe the use of a sub-audible tone transmitted with normal voice audio to open the squelch of a receiver?

A. Carrier squelch
B. Tone burst
C. DTMF
D. CTCSS

T2B03 Which of the following describes the muting of receiver audio controlled solely by the presence or absence of an RF signal?

A. Tone squelch
B. Carrier squelch
C. CTCSS
D. Modulated carrier

T2B04

Which of the following common problems might cause you to be able to hear but not access a repeater even when transmitting with the proper offset?

A. The repeater receiver requires audio tone burst for access
B. The repeater receiver requires a CTCSS tone for access
C. The repeater receiver may require a DCS tone sequence for access
D. All of these choices are correct

T2B05 What determines the amount of deviation of an FM signal?

A. Both the frequency and amplitude of the modulating signal
B. The frequency of the modulating signal
C. The amplitude of the modulating signal
D. The relative phase of the modulating signal and the carrier

T2B06 What happens when the deviation of an FM transmitter is increased?

A. Its signal occupies more bandwidth
B. Its output power increases
C. Its output power and bandwidth increases
D. Asymmetric modulation occurs

T2B07 What should you do if you receive a report that your station's transmissions are causing splatter or interference on nearby frequencies?

A. Increase transmit power
B. Change mode of transmission
C. Report the interference to the equipment manufacturer
D. Check your transmitter for off-frequency operation or spurious emissions

T2B08 What is the proper course of action if your station's transmission unintentionally interferes with another station?

A. Rotate your antenna slightly
B. Properly identify your transmission and move to a different frequency
C. Increase power
D. Change antenna polarization

T2B09 Which of the following methods is encouraged by the FCC when identifying your station when using phone?

A. Use of a phonetic alphabet
B. Send your call sign in CW as well as voice
C. Repeat your call sign three times
D. Increase your signal to full power when identifying

T2B10 What is the "Q" signal used to indicate that you are receiving interference from other stations?

A. QRM
B. QRN
C. QTH
D. QSB

T2B11 What is the "Q" signal used to indicate that you are changing frequency?

A. QRU
B. QSY
C. QSL
D. QRZ

T2C01 What set of rules applies to proper operation of your station when using amateur radio at the request of public service officials?

A. RACES Rules
B. ARES Rules
C. FCC Rules
D. FEMA Rules

T2C04 What do RACES and ARES have in common?

A. They represent the two largest ham clubs in the United States
B. Both organizations broadcast road and weather traffic information
C. Neither may handle emergency traffic supporting public service agencies
D. Both organizations may provide communications during emergencies

T2C05 What is the Radio Amateur Civil Emergency Service?

A. An emergency radio service organized by amateur operators
B. A radio service using amateur stations for emergency management or civil defense communications
C. A radio service organized to provide communications at civic events
D. A radio service organized by amateur operators to assist non-military persons

T2C06

Which of the following is common practice during net operations to get the immediate attention of the net control station when reporting an emergency?

A. Repeat the words SOS three times followed by the call sign of the reporting station
B. Press the push-to-talk button three times
C. Begin your transmission with "Priority" or "Emergency" followed by your call sign
D. Play a pre-recorded emergency alert tone followed by your call sign

T2C07 What should you do to minimize disruptions to an emergency traffic net once you have checked in?

A. Whenever the net frequency is quiet, announce your call sign and location
B. Move 5 kHz away from the net's frequency and use high power to ask other hams to keep clear of the net frequency
C. Do not transmit on the net frequency until asked to do so by the net control station
D. Wait until the net frequency is quiet, then ask for any emergency traffic for your area

T2C08 What is usually considered to be the most important job of an amateur operator when handling emergency traffic messages?

A. Passing messages exactly as written, spoken or as received

B. Estimating the number of people affected by the disaster

C. Communicating messages to the news media for broadcast outside the disaster area

D. Broadcasting emergency information to the general public

T2C09

When may an amateur station use any means of radio communications at its disposal for essential communications in connection with immediate safety of human life and protection of property?

A. Only when FEMA authorizes it by declaring an emergency

B. When normal communications systems are not available

C. Only when RACES authorizes it by declaring an emergency

D. Only when authorized by the local MARS program director

T2C10 What is the preamble in a formal traffic message?

A. The first paragraph of the message text
B. The message number
C. The priority handling indicator for the message
D. The information needed to track the message as it passes through the amateur radio traffic handling system

T2C11 What is meant by the term "check" in reference to a formal traffic message?

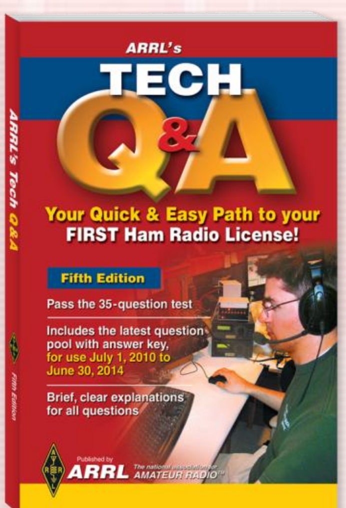
A. The check is a count of the number of words or word equivalents in the text portion of the message

B. The check is the value of a money order attached to the message

C. The check is a list of stations that have relayed the message

D. The check is a box on the message form that tells you the message was received

Technician Licensing Class
"T3"



Valid dates:

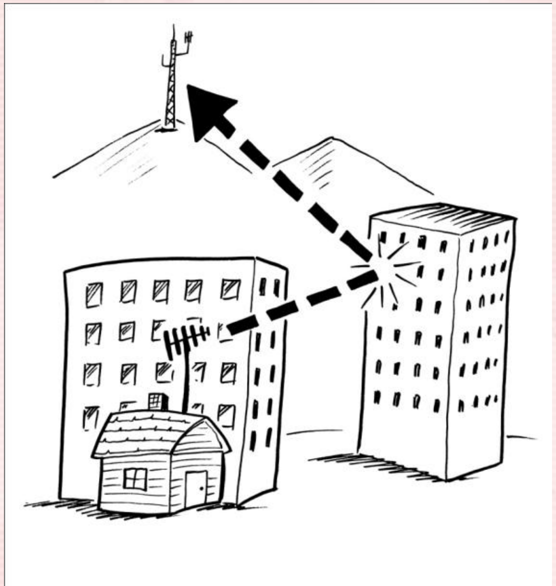
July 1, 2010 – June 30, 2014

Amateur Radio Technician Class
Element 2 Course Presentation

- **ELEMENT 2 SUB-ELEMENTS**
  - **T1 - FCC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities.**
  - **T2 – Operating Procedures**
  - **T3 – Radio wave characteristics, radio and electromagnetic properties, propagation modes**
  - **T4 – Amateur radio practices and station set up**
  - **T5 – Electrical principles, math for electronics, electronic principles, Ohm's Law**
  - **T6 – Electrical components, semiconductors, circuit diagrams, component functions**
  - **T7 – Station equipment, common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing**
  - **T8 – Modulation modes, amateur satellite operation, operating activities, non-voice communications**
  - **T9 – Antennas, feedlines**
  - **T0 – AC power circuits, antenna installation, RF hazards**

T3A: Radio wave characteristics; how a radio signal travels; distinctions of HF, VHF, and UHF; fading, multipath; wavelengths vs. penetration; antenna orientation.

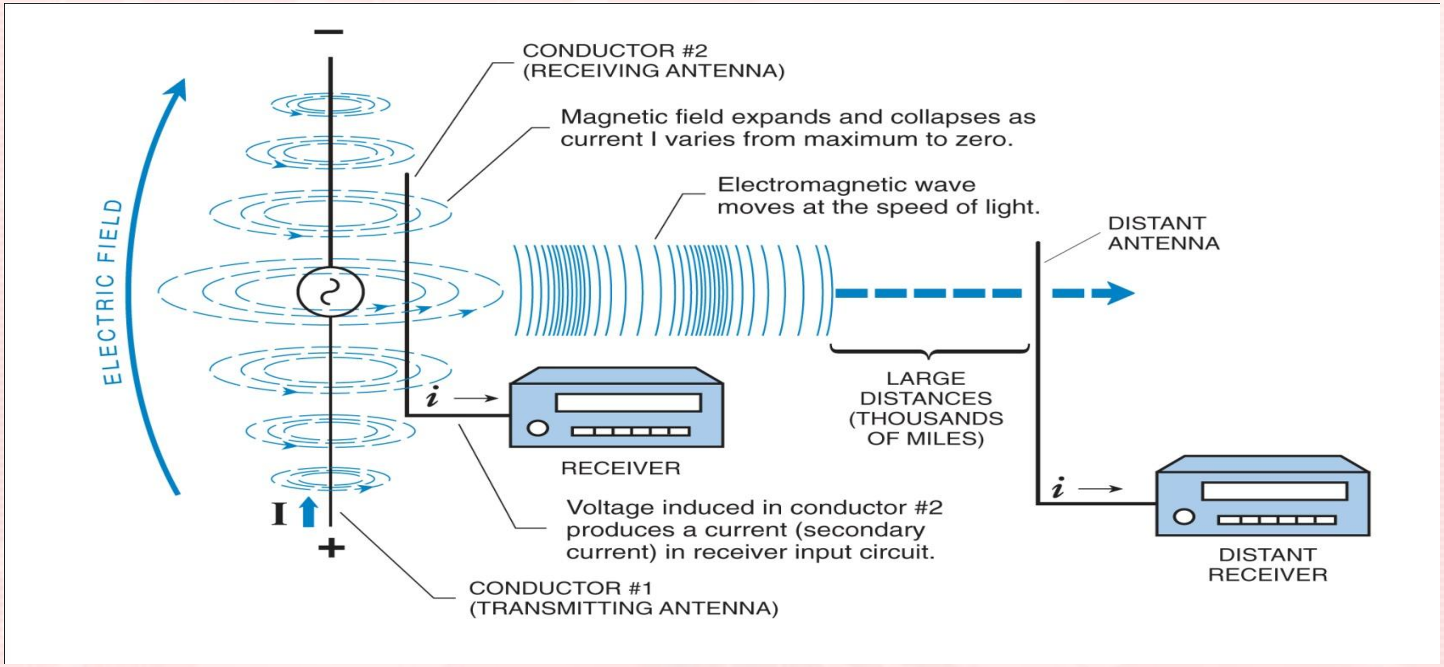
- T3A1 Should another operator reports that your stations 2 meter signals were strong just a moment ago, but now they are weak or distorted, try moving a few feet, as random reflections may be causing multi-path distortion.
- T3A2 UHF signals are often more effective from inside buildings than VHF signals as the shorter wavelength allows them to more easily penetrate the structure of buildings.



UHF signals are short enough in wavelength to permit bouncing around inside buildings and penetrating of walls.

T3A: Radio wave characteristics; how a radio signal travels; distinctions of HF, VHF, and UHF; fading, multipath; wavelengths vs. penetration; antenna orientation.

- T3A3 Horizontal antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands.
- T3A4 Signals could be significantly weaker if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization.

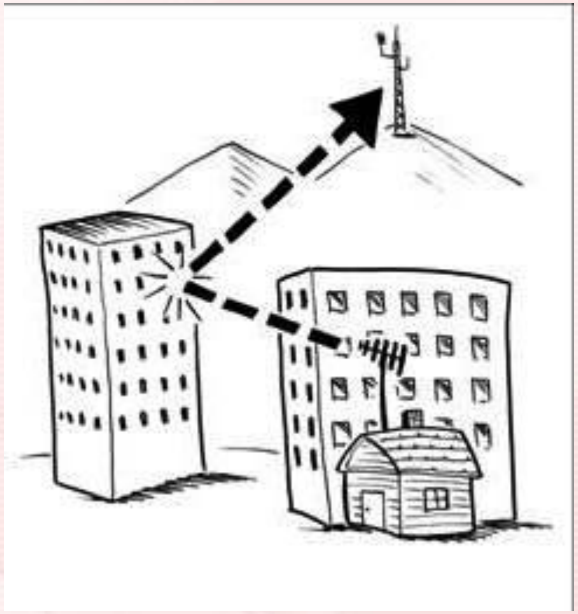


Transmitter to Receiver – Radio waves from transmitting antennas induce signals in receiving antennas as they pass by

T3A: Radio wave characteristics; how a radio signal travels; distinctions of HF, VHF, and UHF; fading, multipath; wavelengths vs. penetration; antenna orientation.

- T3A5 When using a directional antenna, your station might be able to access a distant repeater if buildings or obstructions are blocking the direct line of sight path by finding a path that reflects signals to the repeater.

Directional Antenna can be used to bounce signal to reach repeater blocked by building



T3A: Radio wave characteristics; how a radio signal travels; distinctions of HF, VHF, and UHF; fading, multipath; wavelengths vs. penetration; antenna orientation.

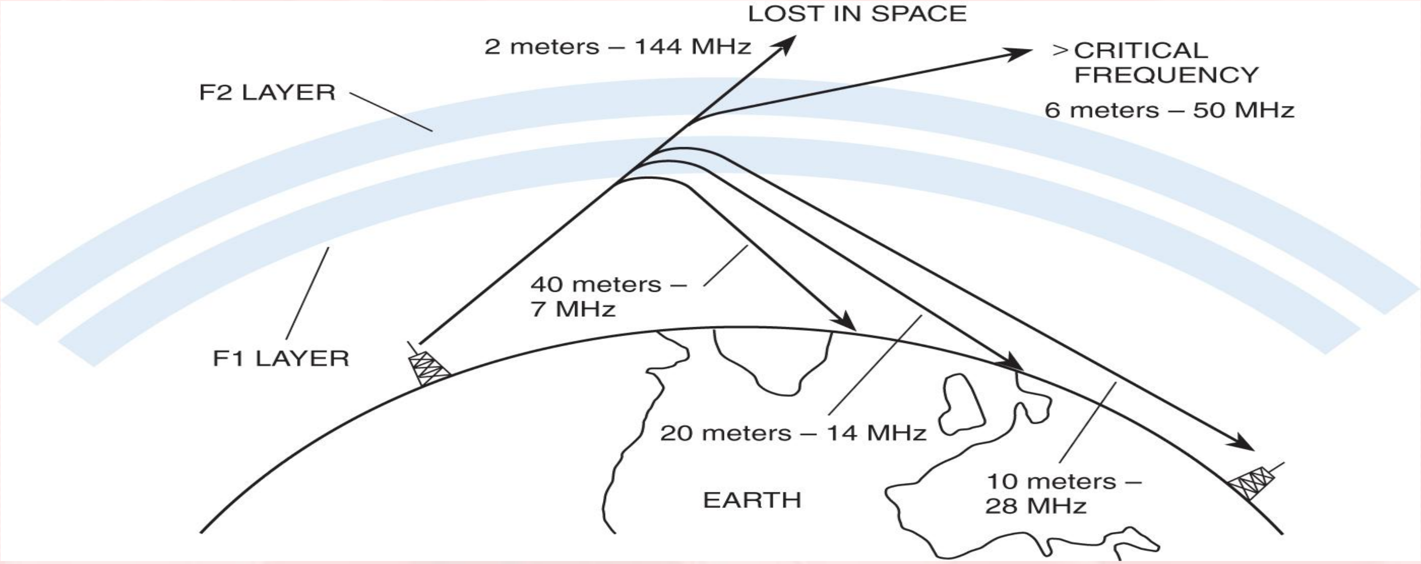
- T3A6 Picket fencing is the term commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting.

- T3A7 Electromagnetic waves carry radio signals between transmitting and receiving stations.

- T3A8 The cause of irregular fading of signals from distant stations during times of generally good reception is due to random combining of signals arriving via different path lengths.

T3A: Radio wave characteristics; how a radio signal travels; distinctions of HF, VHF, and UHF; fading, multipath; wavelengths vs. penetration; antenna orientation.

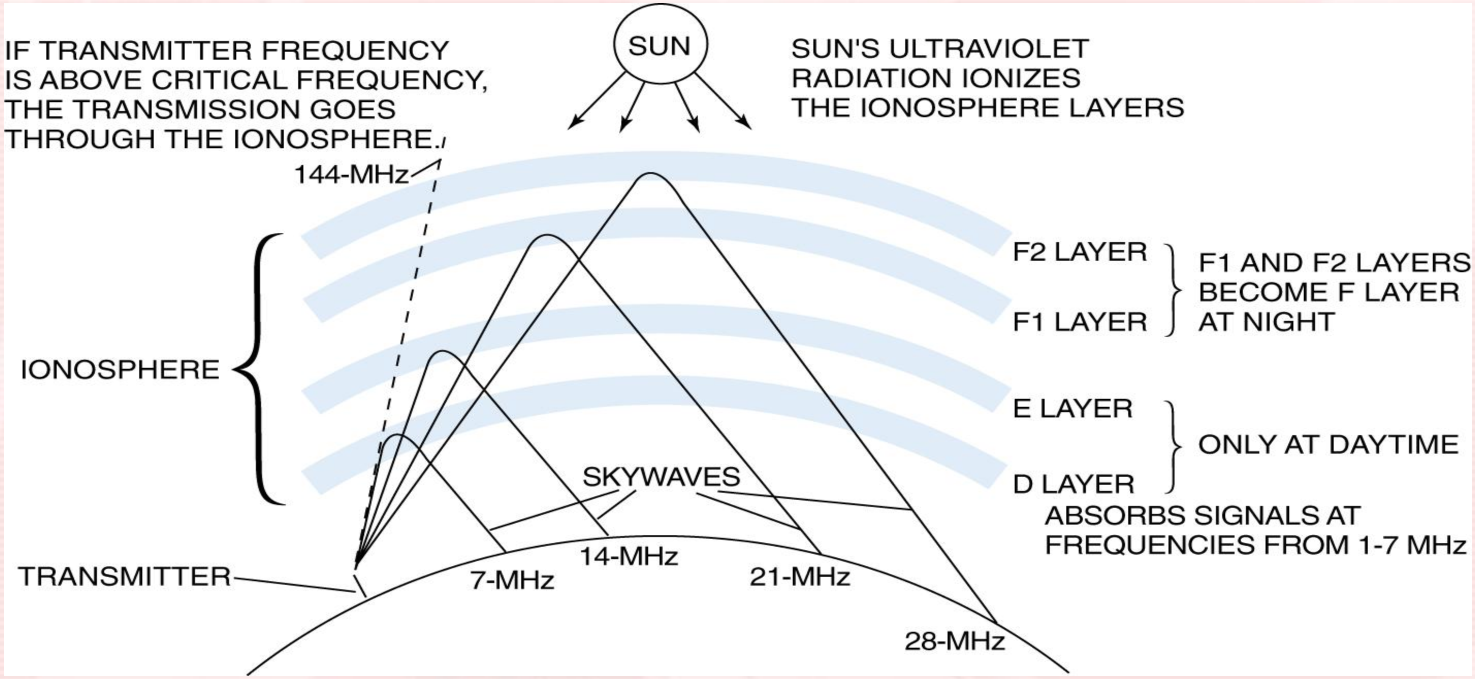
- T3A9 A common effect of "skip" reflections between the Earth and the ionosphere is the polarization of the original signal becomes randomized.
    - Skip happens when signals refract and reflect off the ionosphere.
        - DX stations 1000 miles away come booming in.
    - Every 30 seconds signal goes from strong to weak and back.
        - Caused by random, ever changing polarization of the original signal.



Critical Frequency

T3A: Radio wave characteristics; how a radio signal travels; distinctions of HF, VHF, and UHF; fading, multipath; wavelengths vs. penetration; antenna orientation.

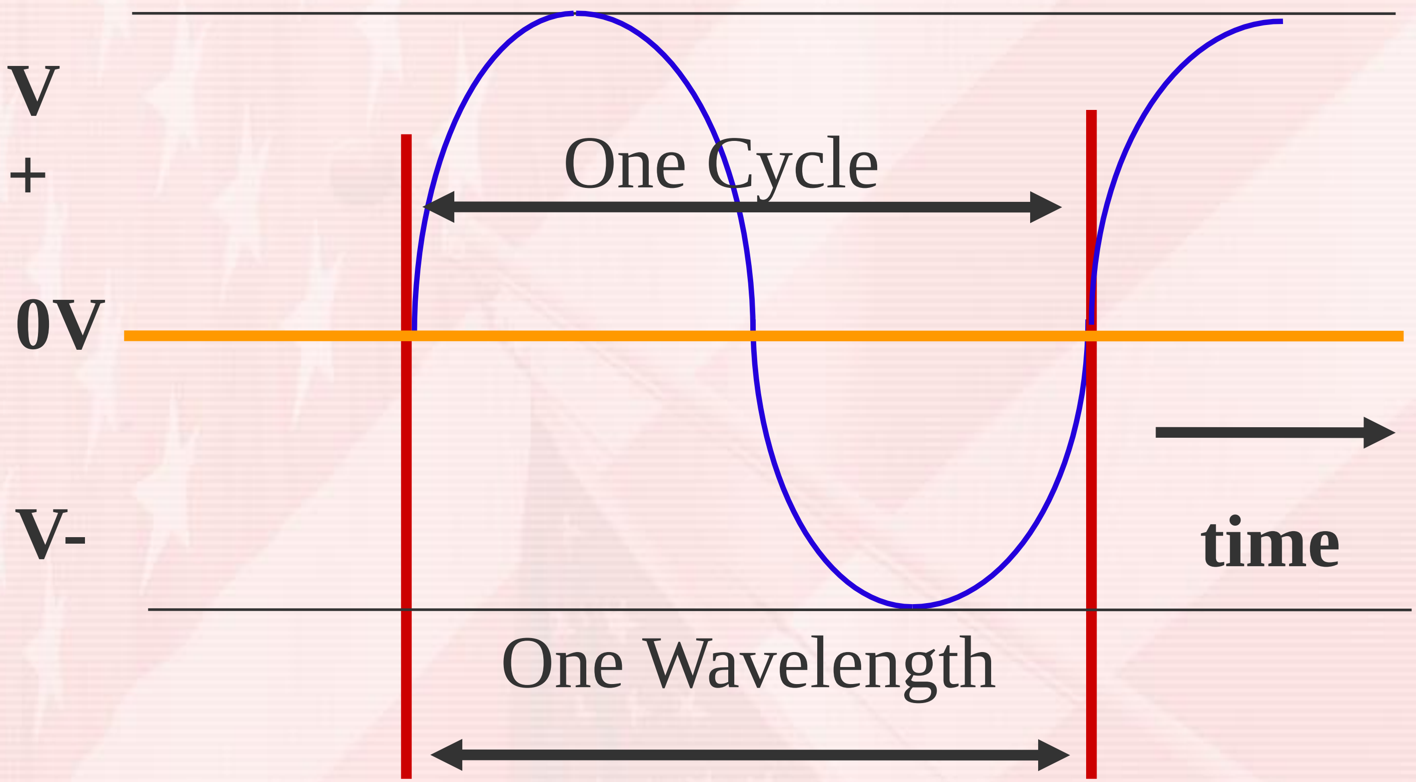
- T3A10 Error rates are likely to increase on VHF or UHF data signals propagated over multiple paths.
- T3A11 The ionosphere is the part of the atmosphere that enables the propagation of radio signals around the world.



Ionosphere and its layers

T3B: Radio and electromagnetic wave properties; the electromagnetic spectrum, wavelength vs. frequency, velocity of electromagnetic waves.

- T3B1 The name for the distance a radio wave travels during one complete cycle is wavelength. Keywords: distance and wavelength
- T3B2 The term that describes the number of times per second that an alternating current reverses direction is frequency.



T3B: Radio and electromagnetic wave properties; the electromagnetic spectrum, wavelength vs. frequency, velocity of electromagnetic waves.

- T3B3 Electric and magnetic fields are the two components of a radio wave.

  They are at right angles to each other and together are called "electromagnetic" radio waves

- T3B4 Radio waves travel through free space at the speed of light.

- T3B5 The wavelength of a radio wave relates to its frequency inversely, as the wavelength gets shorter the frequency increases.
  - Higher in frequency the shorter the distance between each wave.

- T3B6 The formula for converting frequency to wavelength in meters is the wavelength in meters equals 300 divided by frequency in megahertz. (One answer ends with word Megahertz)

Conversions Between Wavelength and Frequency

Converting Frequency to Wavelength

To find wavelength (λ) in meters, if you know fre3quency (f) in megahertz (MHz) Solve:

$$\lambda\text{(meters)} = \frac{300}{f\text{(MHz)}}$$

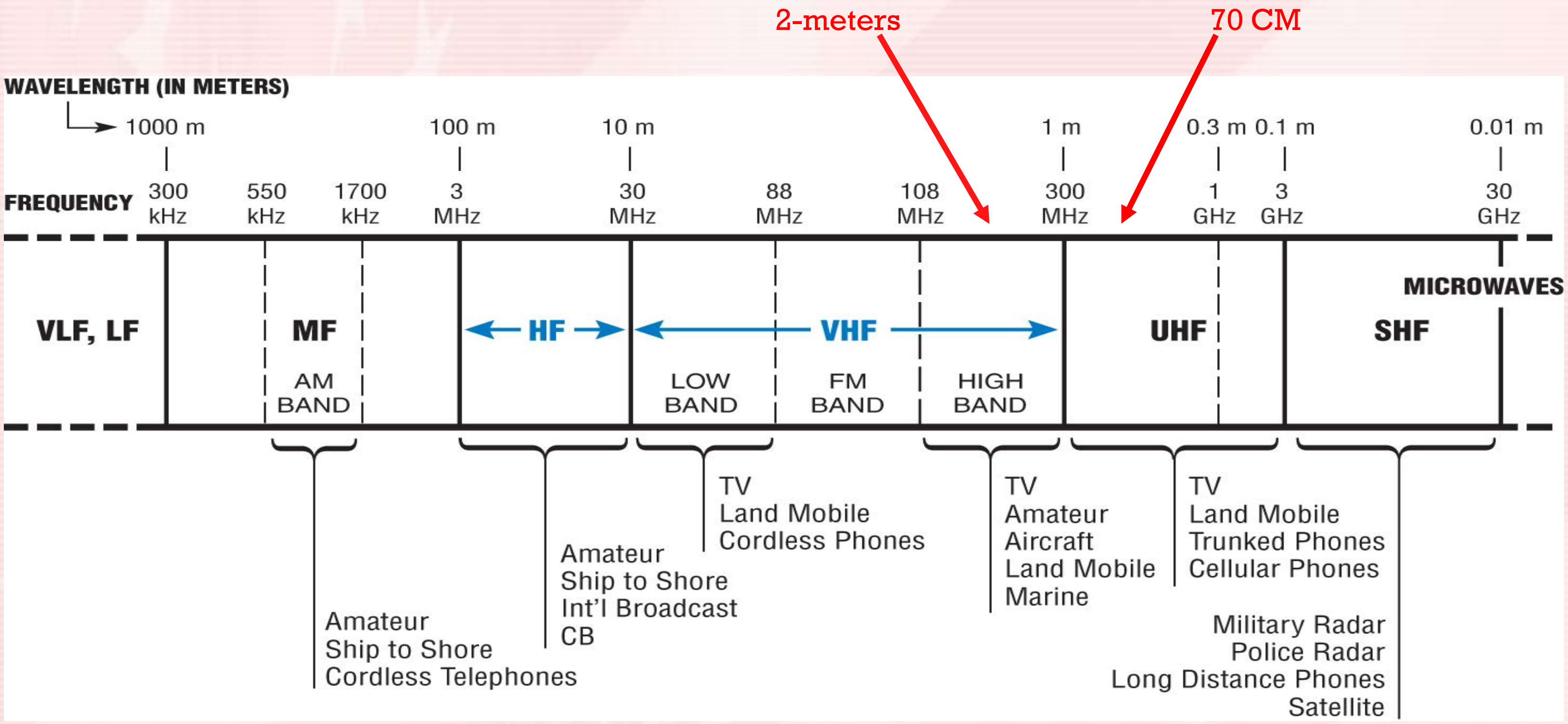
Converting Wavelength to Frequency

To find frequency (f) in megahertz (MHz), if you know wavelength (λ) in meters, Solve:

$$f\text{(MHz)} = \frac{300}{\lambda\text{(meters)}}$$

T3B: Radio and electromagnetic wave properties; the electromagnetic spectrum, vs. frequency, velocity of electromagnetic waves.

- T3B7 The property of radio waves often used to identify the different frequency bands is the approximate wavelength.
  - Wavelength of the band: 2 meters; 20 meters; 40 meters, etc
- T3B8 The frequency limits of the VHF spectrum are 30 MHz to 300 MHz.



T3B: Radio and electromagnetic wave properties; the electromagnetic spectrum, vs. frequency, velocity of electromagnetic waves.

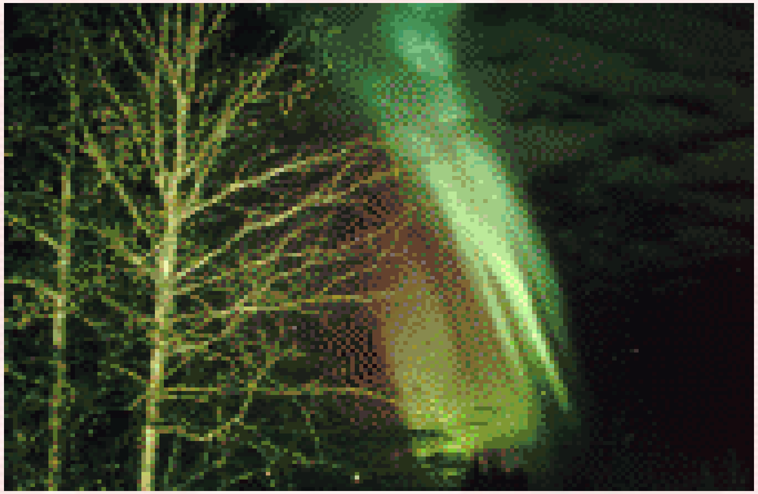
- T3B9 The frequency limits of the UHF spectrum are 300 MHz to 3000 MHz.
    - UHF is 300 MHz to 3000 MHz
- T3B10 The frequency range referred to as HF is 3 MHz to 30 MHz.
- T3B11 The approximate velocity of a radio wave as it travels through free space is 300,000,000 meters per second.

T3C: Propagation modes; line of sight, sporadic E, meteor, aurora scatter, tropospheric ducting, F layer skip, radio horizons

- T3C1 UHF signals "direct" (not via a repeater) are rarely heard from stations outside your local coverage area because UHF signals are usually not reflected by the ionosphere.
  - REFRACTION IN THE IONOSPHERE:
    - When a radio wave is transmitted into an ionized layer, refraction, or bending of the wave, occurs.
    - Refraction is caused by an abrupt change in the velocity of the upper part of a radio wave as it strikes or enters a new medium.
    - The amount of refraction that occurs depends on three main factors:
      - (1) the density of ionization of the layer,
      - (2) the frequency of the radio wave,
      - (3) the angle at which the wave enters the layer
  - REFLECTION IN THE IONOSPHERE:
    - When a radio wave hits an obstacle, some or all of the wave is reflected, with a loss of intensity.
    - Reflection is such that the angle of incidence is equal to the angle of reflection.

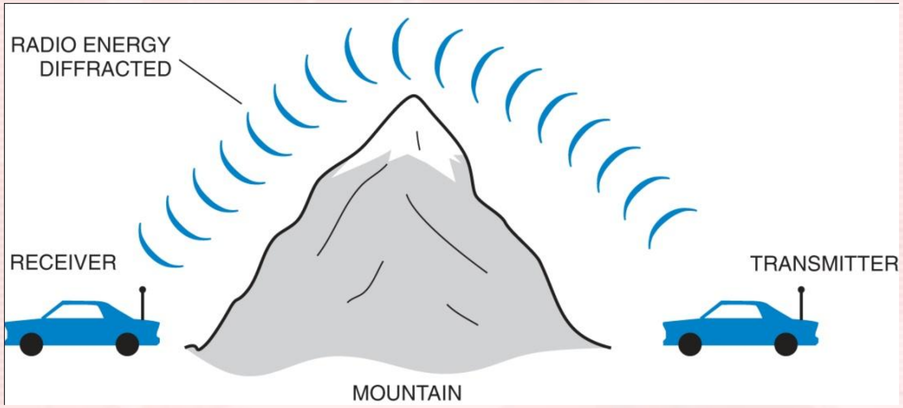
T3C: Propagation modes; line of sight, sporadic E, meteor, aurora scatter, tropospheric ducting, F layer skip, radio horizons

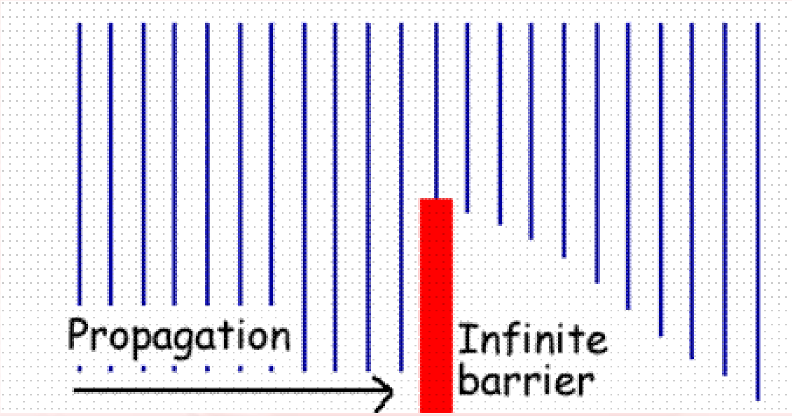
- T3C2 When VHF signals are being received from long distances these signals are being refracted from a sporadic E layer.
    - Sporadic-E refractions off ionized patches of the ionospheric E-layer are common in summer on 6-meters.
- T3C3 A characteristic of VHF signals received via auroral reflection is that the signals exhibit rapid fluctuations of strength and often sound distorted.



Incoming signals from a distant station heard hundreds of miles away will sound fluttery and distorted by auroral bounce

- T3C4 Sporadic E propagation is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands.
- T3C5 The term "knife-edge" propagation refers to signals that are partially refracted around solid objects exhibiting sharp edges.

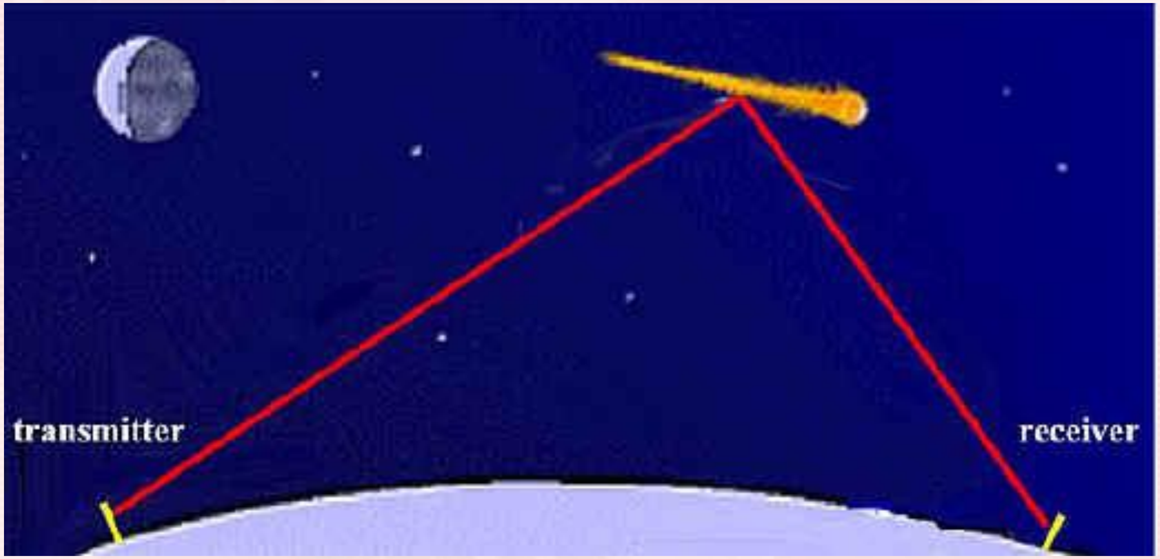




Knife-Edge Diffraction

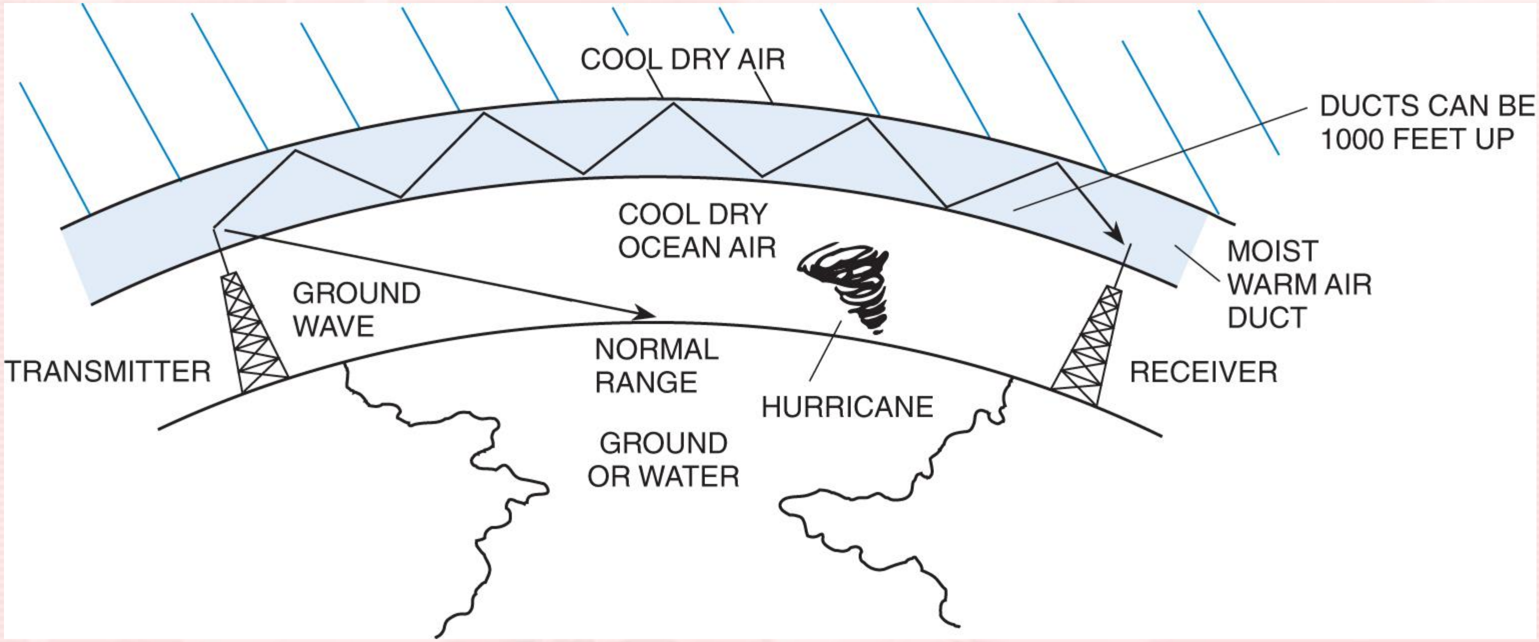
T3C: Propagation modes; line of sight, sporadic E, meteor, aurora scatter, tropospheric ducting, F layer skip, radio horizons

- T3C6 Tropospheric scatter is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis.
- T3C7 The 6 meter band is best suited to communicating via meteor scatter.
  - Leonids and Geminids meteor showers provide these conditions
  - Bounce signals off meteor tail



T3C: Propagation modes; line of sight, sporadic E, meteor, aurora scatter, tropospheric ducting, F layer skip, radio horizons

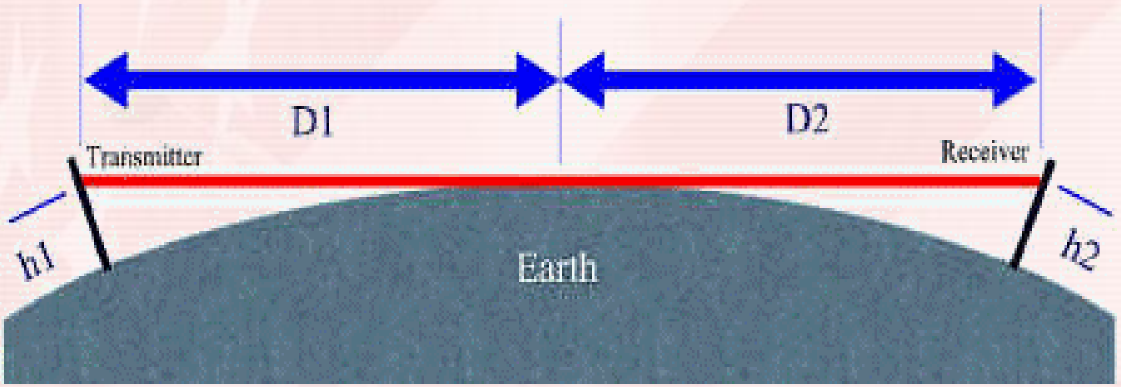
- T3C8 Temperature inversions in the atmosphere causes "tropospheric ducting".



Tropospheric Ducting

T3C: Propagation modes; line of sight, sporadic E, meteor, aurora scatter, tropospheric ducting, F layer skip, radio horizons

- T3C9 During daylight hours is generally the best time for long-distance 10 meter band propagation.
- T3C10 The distance at which radio signals between two points are effectively blocked by the curvature of the Earth is the radio horizon.
  - VHF & UHF radio signals will generally travel "line of sight."
  - VHF & UHF radio signals are blocked by the curvature of the Earth.



- T3C11 VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations because the Earth seems less curved to radio waves than to light.

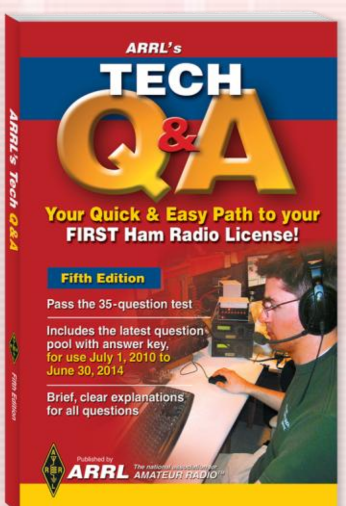
  - the Earth seems less curved to VHF and UHF radio signals.

Element 2 Technician Class Question Pool

T3

Radio wave characteristics, radio and electromagnetic properties, propagation modes

[3 Exam Questions – 3 Groups]



Valid July 1, 2010

Through

June 30, 2014

T3A01 What should you do if another operator reports that your station's 2 meter signals were strong just a moment ago, but now they are weak or distorted?

A. Change the batteries in your radio to a different type
B. Turn on the CTCSS tone
C. Ask the other operator to adjust his squelch control
D. Try moving a few feet, as random reflections may be causing multi-path distortion

T3A02 Why are UHF signals often more effective from inside buildings than VHF signals?

A. Change the batteries in your radio to a different type
B. The shorter wavelength allows them to more easily penetrate the structure of buildings
C. This is incorrect; VHF works better than UHF inside buildings
D. UHF antennas are more efficient than VHF antennas

T3A03 What antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands?

A. Right-hand circular
B. Left-hand circular
C. Horizontal
D. Vertical

T3A04 What can happen if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization?

A. The modulation sidebands might become inverted
B. Signals could be significantly weaker
C. Signals have an echo effect on voices
D. Nothing significant will happen

T3A05

When using a directional antenna, how might your station be able to access a distant repeater if buildings or obstructions are blocking the direct line of sight path?

A. Change from vertical to horizontal polarization
B. Try to find a path that reflects signals to the repeater
C. Try the long path
D. Increase the antenna SWR

T3A06 What term is commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting?

A. Flip-flopping
B. Picket fencing
C. Frequency shifting
D. Pulsing

T3A07 What type of wave carries radio signals between transmitting and receiving stations?

A. Electromagnetic
B. Electrostatic
C. Surface acoustic
D. Magnetostrictive

T3A08 What is the cause of irregular fading of signals from distant stations during times of generally good reception.

A. Absorption of signals by the "D" layer of the ionosphere
B. Absorption of signals by the "E" layer of the ionosphere
C. Random combining of signals arriving via different path lengths
D. Intermodulation distortion in the local receiver

T3A09 Which of the following is a common effect of "skip" reflections between the Earth and the ionosphere?

A. The sidebands become reversed at each reflection
B. The polarization of the original signal is randomized
C. The apparent frequency of the received signal is shifted by a random amount
D. Signals at frequencies above 30 MHz become stronger with each reflection

T3A10 What may occur if VHF or UHF data signals propagate over multiple paths?

A. Transmission rates can be increased by a factor equal to the number of separate paths observed
B. Transmission rates must be decreased by a factor equal to the number of separate paths observed
C. No significant changes will occur if the signals are transmitting using FM
D. Error rates are likely to increase

T3A11 Which part of the atmosphere enables the propagation of radio signals around the world?

A. The stratosphere
B. The troposphere
C. The ionosphere
D. The magnetosphere

T3B01 What is the name for the distance a radio wave travels during one complete cycle?

A. Wave speed
B. Waveform
C. Wavelength
D. Wave spread

T3B02 What term describes the number of times per second that an alternating current reverses direction?

A. Pulse rate
B. Speed
C. Wavelength
D. Frequency

T3B03 What are the two components of a radio wave?

A. AC and DC
B. Voltage and current
C. Electric and magnetic fields
D. Ionizing and non-ionizing radiation

T3B04 How fast does a radio wave travel through free space?

A. At the speed of light
B. At the speed of sound
C. Its speed is inversely proportional to its wavelength
D. Its speed increases as the frequency increases

T3B05 How does the wavelength of a radio wave relate to its frequency?

A. The wavelength gets longer as the frequency increases
B. The wavelength gets shorter as the frequency increases
C. There is no relationship between wavelength and frequency
D. The wavelength depends on the bandwidth of the signal

T3B06 What is the formula for converting frequency to wavelength in meters?

A. Wavelength in meters equals frequency in hertz multiplied by 300
B. Wavelength in meters equals frequency in hertz divided by 300
C. Wavelength in meters equals frequency in megahertz divided by 300
D. Wavelength in meters equals 300 divided by frequency in megahertz

T3B07 What property of radio waves is often used to identify the different frequency bands?

A. The approximate wavelength
B. The magnetic intensity of waves
C. The time it takes for waves to travel one mile
D. The voltage standing wave ratio of waves

T3B08 What are the frequency limits of the VHF spectrum?

A. 30 to 300 kHz
B. 30 to 300 MHz
C. 300 to 3000 kHz
D. 300 to 3000 MHz

T3B09 What are the frequency limits of the UHF spectrum?

A. 30 to 300 kHz
B. 30 to 300 MHz
C. 300 to 3000 kHz
D. 300 to 3000 MHz

T3B10 What frequency range is referred to as HF?

A. 300 to 3000 MHz
B. 30 to 300 MHz
C. 3 to 30 MHz
D. 300 to 3000 kHz

T3B11 What is the approximate velocity of a radio wave as it travels through free space?

A. 3000 kilometers per second
B. 300,000,000 meters per second
C. 300,000 miles per hour
D. 186,000 miles per hour

T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?

A. They are too weak to go very far
B. FCC regulations prohibit them from going more than 50 miles
C. UHF signals are usually not reflected by the ionosphere
D. They collide with trees and shrubbery and fade out

T3C02 Which of the following might be happening when VHF signals are being received from long distances?

A. Signals are being reflected from outer space
B. Signals are arriving by sub-surface ducting
C. Signals are being reflected by lightning storms in your area
D. Signals are being refracted from a sporadic E layer

T3C03 What is a characteristic of VHF signals received via auroral reflection?

A. Signals from distances of 10,000 or more miles are common
B. The signals exhibit rapid fluctuations of strength and often sound distorted
C. These types of signals occur only during winter nighttime hours
D. These types of signals are generally strongest when your antenna is aimed to the south (for stations in the Northern Hemisphere)

T3C04 Which of the following propagation types is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands?

A. Backscatter
B. Sporadic E
C. D layer absorption
D. Gray-line propagation

T3C05 What is meant by the term "knife-edge" propagation?

A. Signals are reflected back toward the originating station at acute angles
B. Signals are sliced into several discrete beams and arrive via different paths
C. Signals are partially refracted around solid objects exhibiting sharp edges
D. Signals propagated close to the band edge exhibiting a sharp cutoff

T3C06 What mode is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis?

A. Tropospheric scatter
B. D layer refraction
C. F2 layer refraction
D. Faraday rotation

T3C07 What band is best suited to communicating via meteor scatter?

A. 10 meters
B. 6 meters
C. 2 meters
D. 70 cm

T3C08 What causes "tropospheric ducting"?

A. Discharges of lightning during electrical storms
B. Sunspots and solar flares
C. Updrafts from hurricanes and tornadoes
D. Temperature inversions in the atmosphere

T3C09 What is generally the best time for long-distance 10 meter band propagation?

A. During daylight hours
B. During nighttime hours
C. When there are coronal mass ejections
D. Whenever the solar flux is low

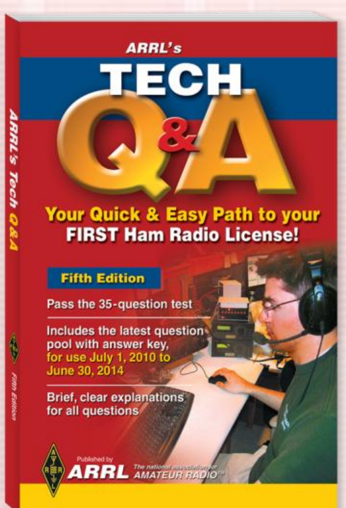
T3C10 What is the radio horizon?

A. The distance at which radio signals between two points are effectively blocked by the curvature of the Earth
B. The distance from the ground to a horizontally mounted antenna
C. The farthest point you can see when standing at the base of your antenna tower
D. The shortest distance between two points on the Earth's surface

T3C11 Why do VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations?

A. Radio signals move somewhat faster than the speed of light
B. Radio waves are not blocked by dust particles
C. The Earth seems less curved to radio waves than to light
D. Radio waves are blocked by dust particles

Technician Licensing Class
“T4”



Valid dates:

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  - **T9 – Antennas, feedlines**
  - **T0 – AC power circuits, antenna installation, RF hazards**

T4A: Station setup; microphone, speaker, headphones, filters, power source, connecting a computer, RF grounding

- T4A1 Concerning the microphone connectors on amateur transceivers, some connectors include push-to-talk and voltages for powering the microphone.

T4A: Station setup; microphone, speaker, headphones, filters, power source, connecting a computer, RF grounding

- T4A2 A set of headphones could be used in place of a regular speaker to help you copy signals in a noisy area.

- T4A3 Preventing voltage fluctuations from reaching sensitive circuits is a good reason to use a regulated power supply for communications equipment.

MFJ-4125 13.8VDC@22Amp

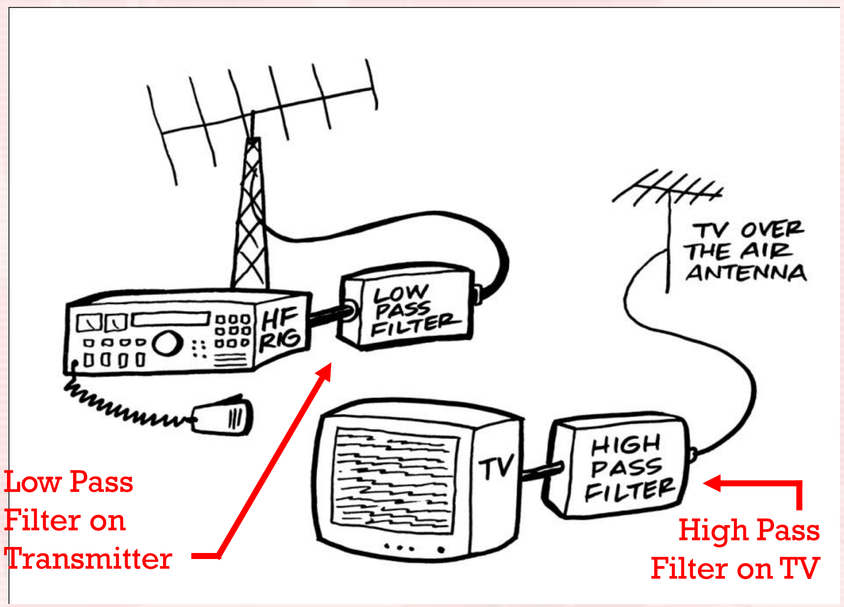
Jetstream JTPS30M Regulated Power Supply

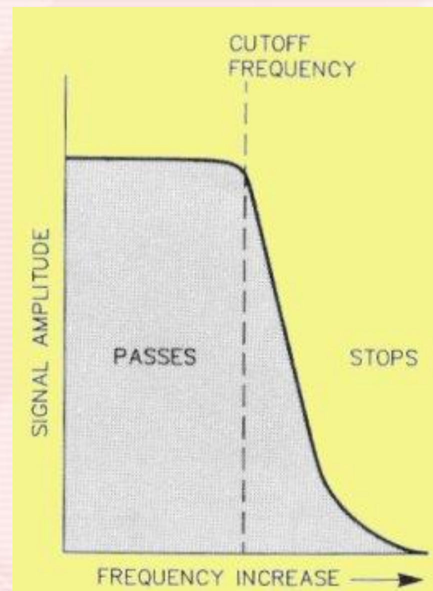
- T4A4 Install a filter between the transmitter and antenna to reduce harmonic emissions.

Drake TV-3300-LP Low Pass Filter.
80 db attenuation above 41 MHz.
1000 Watts below 30 MHz.

There are low-pass filters like this one, band-pass filters, and high-pass filters that can be used to solve interference problems.

- T4A5 A band-reject filter should be connected to a TV receiver as the first step in trying to prevent RF overload from a nearby 2 meter transmitter.



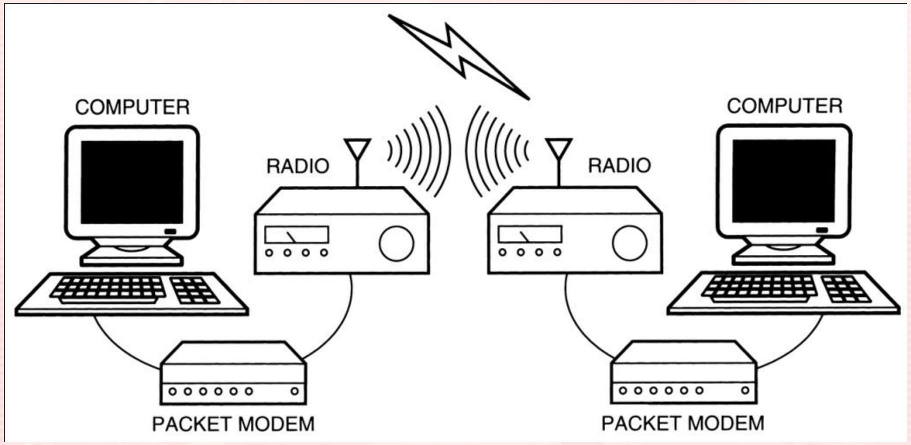


Passes low frequencies and cuts high frequencies

Low Pass Filter

T4A: Station setup; microphone, speaker, headphones, filters, power source, connecting a computer, RF grounding

- T4A6 A terminal node controller would be connected between a transceiver and computer in a packet radio station.

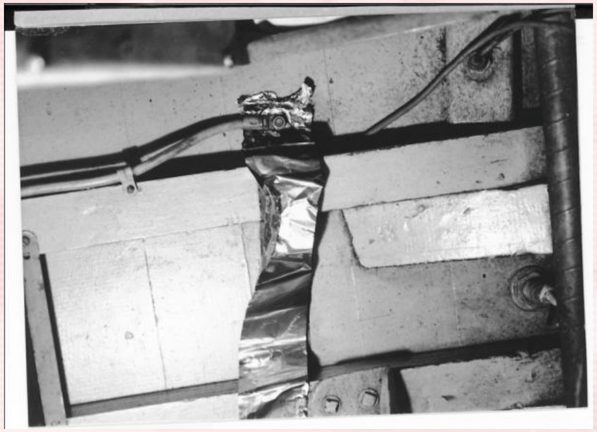


A Packet Radio System.

Some Packet equipment

T4A: Station setup; microphone, speaker, headphones, filters, power source, connecting a computer, RF grounding

- T4A7 The sound card provides audio to the microphone input and converts received audio to digital form when conducting digital communications using a computer.
- T4A8 A Flat strap conductor is best to use for RF grounding.
  - Offers best surface area
    - Bleed off static and minimize ground currents
    - Straps usually are 3 inches wide
    - Folding okay to snake down to a healthy ground rod



Copper Foil Ground Strap Provides Good Surface Area Ground

T4A: Station setup; microphone, speaker, headphones, filters, power source, connecting a computer, RF grounding

- T4A9 You would use a ferrite choke to reduce RF current flowing on the shield of an audio cable.

Clam shell iron devices just snap on over wiring

- T4A10 The alternator is the source of a high-pitched whine that varies with engine speed in a mobile transceiver's receive audio.
- T4A11 A mobile transceiver's power negative connection should be made at the battery or engine block ground strap.
  - Ham radio power leads need to be connected directly at the battery source.

T4B: Operating controls; tuning, use of filters, squelch, AGC, repeater offset, memory channels

- T4B1 If a transmitter is operated with the microphone gain set too high the output signal might become distorted.

- T4B2 The keypad or VFO knob can be used to enter the operating frequency on a modern transceiver.
    - VFO – **V**ariable **F**requency **O**scillator

VFO knob

Mic Keypad

T4B: Operating controls; tuning, use of filters, squelch, AGC, repeater offset, memory channels

- T4B3 The purpose of the squelch control on a transceiver is to mute receiver output noise when no signal is being received.
    - Squelch control silences the background noise

squelch control

squelch control

- T4B4 Quick access to a favorite frequency on your transceiver can be done by storing the frequency in a memory channel.

With a transceiver (HT) like one of these, you can hold your ham station in the palm of your hand.

- T4B5 Turning on the noise blanker would reduce ignition interference to a receiver.
  - Not on common FM handheld or mobile FM radios
  - On bigger high-frequency, multi-mode tranceiver

Even this older Icom 730 has the NB function

PreAmp built in

NB – Noise Blanker

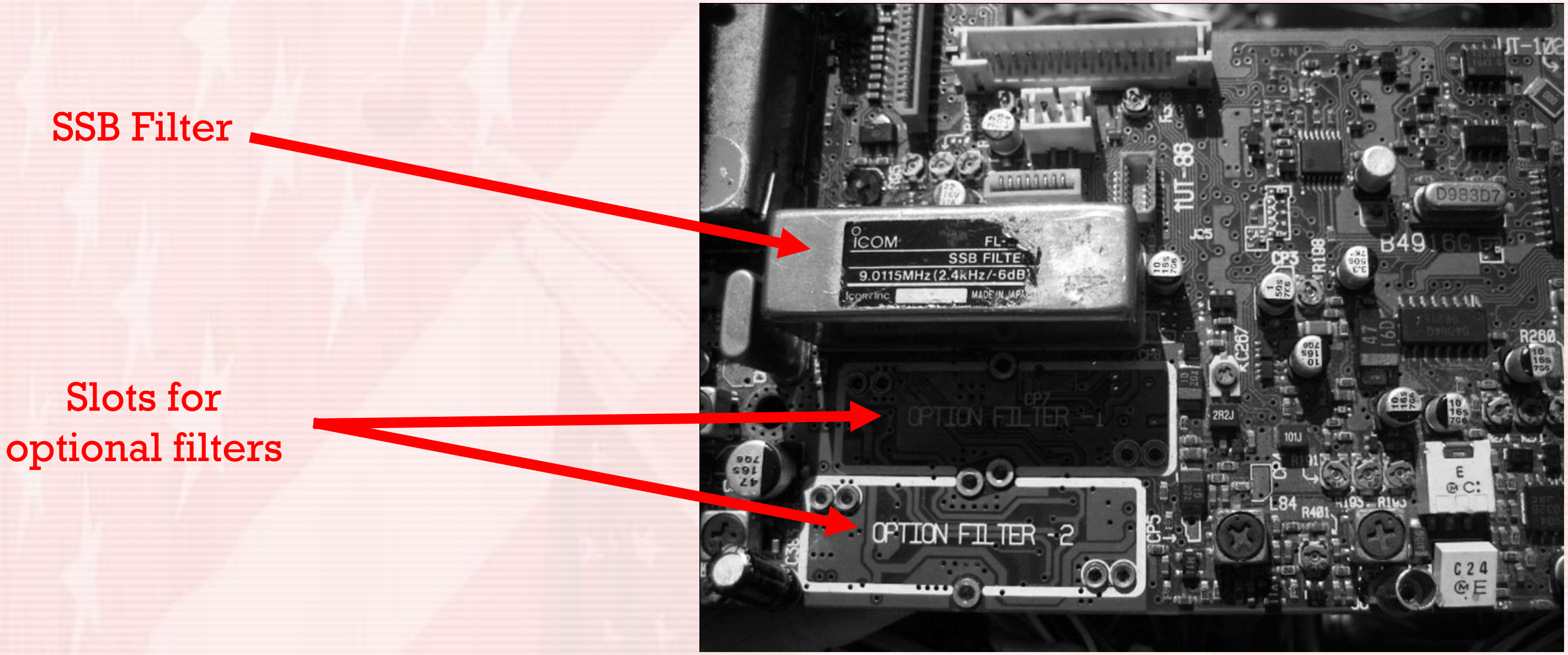
T4B: Operating controls; tuning, use of filters, squelch, AGC, repeater offset, memory channels

- T4B6 The receiver RIT or clarifier controls could be used if the voice pitch of a single-sideband signal seems too high or low.
- T4B7 The term "RIT" means **R**eceiver **I**ncremental **T**uning.

Set knob to neutral, press RIT button to turn on function, and then adjust slightly for proper SSB voice reception

RIT adjusts voice pitch, not the frequency of received station.

- T4B8 The advantage of having multiple receive bandwidth choices on a multimode transceiver will permit noise or interference reduction by selecting a bandwidth matching the mode.
- T4B9 2400 Hz is an appropriate receive filter to select in order to minimize noise and interference for SSB reception.



Receiver section in a communications transceiver

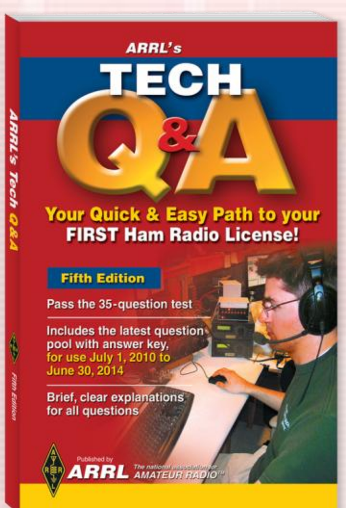
T4B: Operating controls; tuning, use of filters, squelch, AGC, repeater offset, memory channels

- T4B10 500 Hz is an appropriate receive filter to select in order to minimize noise and interference for CW reception.
  - Bandwidth filters vary for the mode being received.

- T4B11 The difference between the repeater's transmit and receive frequencies describes the common meaning of the term “repeater offset”.

Element 2 Technician Class Question Pool

T4
Amateur radio practices and station set up
[2 Exam Questions – 2 Groups]



Valid July 1, 2010

Through

June 30, 2014

T4A01 Which of the following is true concerning the microphone connectors on amateur transceivers?

A. All transceivers use the same microphone connector type

B. Some connectors include push-to-talk and voltages for powering the microphone

C. All transceivers using the same connector type are wired identically

D. Un-keyed connectors allow any microphone to be connected

T4A02 What could be used in place of a regular speaker to help you copy signals in a noisy area?

A. A video display
B. A low pass filter
C. A set of headphones
D. A boom microphone

T4A03 Which is a good reason to use a regulated power supply for communications equipment?

A. It prevents voltage fluctuations from reaching sensitive circuits
B. A regulated power supply has FCC approval
C. A fuse or circuit breaker regulates the power
D. Power consumption is independent of load

T4A04 Where must a filter be installed to reduce harmonic emissions?

A. Between the transmitter and the antenna
B. Between the receiver and the transmitter
C. At the station power supply
D. At the microphone

T4A05 What type of filter should be connected to a TV receiver as the first step in trying to prevent RF overload from a nearby 2 meter transmitter?

A. Low-pass filter
B. High-pass filter
C. Band-pass filter
D. Band-reject filter

T4A06 Which of the following would be connected between a transceiver and computer in a packet radio station?

A. Transmatch
B. Mixer
C. Terminal node controller
D. Antenna

T4A07 How is the computer's sound card used when conducting digital communications using a computer?

A. The sound card communicates between the computer CPU and the video display
B. The sound card records the audio frequency for video display
C. The sound card provides audio to the microphone input and converts received audio to digital form
D. All of these choices are correct

T4A08 Which type of conductor is best to use for RF grounding?

A. Round stranded wire
B. Round copper-clad steel wire
C. Twisted-pair cable
D. Flat strap

T4A09 Which would you use to reduce RF current flowing on the shield of an audio cable?

A. Band-pass filter
B. Low-pass filter
C. Preamplifier
D. Ferrite choke

T4A10 What is the source of a high-pitched whine that varies with engine speed in a mobile transceiver's receive audio?

A. The ignition system
B. The alternator
C. The electric fuel pump
D. Anti-lock braking system controllers

T4A11 Where should a mobile transceiver's power negative connection be made?

A. At the battery or engine block ground strap
B. At the antenna mount
C. To any metal part of the vehicle
D. Through the transceiver's mounting bracket

T4B01 What may happen if a transmitter is operated with the microphone gain set too high?

A. The output power might be too high
B. The output signal might become distorted
C. The frequency might vary
D. The SWR might increase

T4B02 Which of the following can be used to enter the operating frequency on a modern transceiver?

A. The keypad or VFO knob
B. The CTCSS or DTMF encoder
C. The Automatic Frequency Control
D. All of these choices are correct

T4B03 What is the purpose of the squelch control on a transceiver?

A. To set the highest level of volume desired
B. To set the transmitter power level
C. To adjust the automatic gain control
D. To mute receiver output noise when no signal is being received

T4B04 What is a way to enable quick access to a favorite frequency on your transceiver?

A. Enable the CTCSS tones
B. Store the frequency in a memory channel
C. Disable the CTCSS tones
D. Use the scan mode to select the desired frequency

T4B05 Which of the following would reduce ignition interference to a receiver?

A. Change frequency slightly
B. Decrease the squelch setting
C. Turn on the noise blanker
D. Use the RIT control

T4B06 Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?

A. The AGC or limiter
B. The bandwidth selection
C. The tone squelch
D. The receiver RIT or clarifier

T4B07 What does the term "RIT" mean?

A. Receiver Input Tone
B. Receiver Incremental Tuning
C. Rectifier Inverter Test
D. Remote Input Transmitter

T4B08 What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?

A. Permits monitoring several modes at once
B. Permits noise or interference reduction by selecting a bandwidth matching the mode
C. Increases the number of frequencies that can be stored in memory
D. Increases the amount of offset between receive and transmit frequencies

T4B09

Which of the following is an appropriate receive filter to select in order to minimize noise and interference for SSB reception?

A. 500 Hz
B. 1000 Hz
C. 2400 Hz
D. 5000 Hz

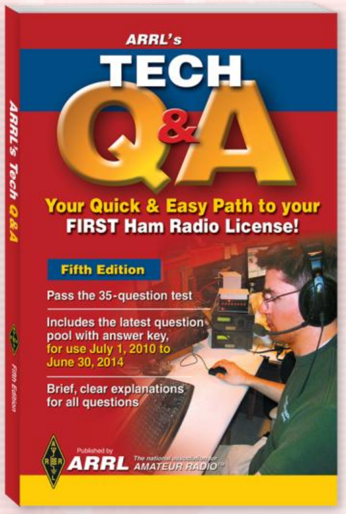
T4B10 Which of the following is an appropriate receive filter to select in order to minimize noise and interference for CW reception?

A. 500 Hz
B. 1000 Hz
C. 2400 Hz
D. 5000 Hz

T4B11 Which of the following describes the common meaning of the term “repeater offset”?

A. The distance between the repeater’s transmit and receive antennas
B. The time delay before the repeater timer resets
C. The difference between the repeater’s transmit and receive frequencies
D. The maximum frequency deviation permitted on the repeater’s input signal

Technician Licensing Class
“T5”



Valid dates:

July 1, 2010 – June 30, 2014

- **ELEMENT 2 SUB-ELEMENTS**
  - **T1 - FCC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities.**
  - **T2 – Operating Procedures**
  - **T3 – Radio wave characteristics, radio and electromagnetic properties, propagation modes**
  - **T4 – Amateur radio practices and station set up**
  - **T5 – Electrical principles, math for electronics, electronic principles, Ohm's Law**
  - **T6 – Electrical components, semiconductors, circuit diagrams, component functions**
  - **T7 – Station equipment, common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing**
  - **T8 – Modulation modes, amateur satellite operation, operating activities, non-voice communications**
  - **T9 – Antennas, feedlines**
  - **T0 – AC power circuits, antenna installation, RF hazards**

T5A: Electrical principles; current and voltage, conductors and insulators, alternating and direct current

- T5A1 Electrical current is measured in amperes.
- T5A2 Electrical power is measured in watts.
  - The power meter outside is called 'watt meter'
- T5A3 Current is the name for the flow of electrons in an electric circuit.
  - Think of the flow of water in a pipe (not the force)
- T5A4 Direct current is the name for a current that flows only in one direction.

T5A: Electrical principles; current and voltage, conductors and insulators, alternating and direct current

- T5A5 Voltage is the electrical term for the **e**lectro**m**otive **f**orce (EMF) that causes electron flow.
  - Think of voltage as water pressure in the pipes (not the flow)
- T5A6 A mobile transceiver usually requires about 12 volts.
- T5A7 Copper is a good electrical conductor.

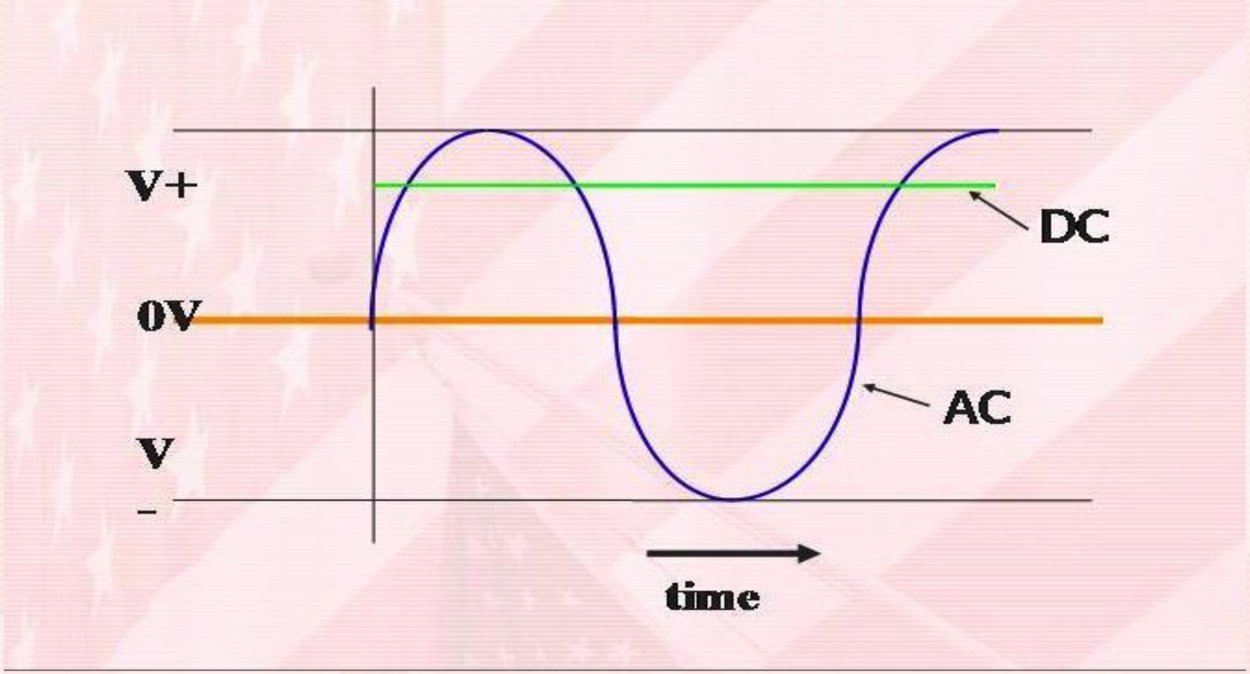
Copper is a good conductor

- T5A8 Glass is a good electrical insulator.

Glass is a good insulator

T5A: Electrical principles; current and voltage, conductors and insulators, alternating and direct current

- T5A9 Alternating current is the name for a current that reverses direction on a regular basis.



- T5A10 Power is the term that describes the rate at which electrical energy is used.
- T5A11 The volt is the basic unit of electromotive force.

T5B: Math for electronics; decibels, electrical units and the metric system

- T5B1 1,500 milliamperes is 1.5 amperes.
- T5B2 1500 kHz is another way to specify a radio signal frequency of 1,500,000 hertz.
- T5B3 One thousand volts are equal to one kilovolt.
- T5B4 One one-millionth of a volts is equal to one microvolt.
- T5B5 0.5 watts is equivalent to 500 milliwatts.
- T5B6 If an ammeter calibrated in amperes is used to measure a 3000-milliampere of current, the reading would it to be 3 amperes.

T5B: Math for electronics; decibels, electrical units and the metric system

Metric	Exponent	English
Tera	10^{12}	Trillion
Giga	10^{9}	Billion
Mega	10^{6}	**Million**
Kilo	10^{3}	**Thousand**
Centi	10^{-2}	Hundredth
Milli	10^{-3}	**Thousandth**
Micro	10^{-6}	**Millionth**
Nano	10^{-9}	Billionth
Pico	10^{-12}	**Trillionth**

Scientific Notation

Prefix		Multiplication Factor	Prefix		Multiplication Factor
tera	10^{12}	1,000,000,000,000	deci	10^{-1}	0.1
giga	10^{9}	1,000,000,000	centi	10^{-2}	0.01
mega	10^{6}	1,000,000	milli	10^{-3}	0.001
kilo	10^{3}	1,000	micro	10^{-6}	0.000001
hecto	10^{2}	100	nano	10^{-9}	0.000000001
deca	10^{1}	10	pico	10^{-12}	0.000000000001
unit	10^{0}	1	femto	10^{-15}	0.000000000000001

T5B: Math for electronics; decibels, electrical units and the metric system

- T5B7 If a frequency readout calibrated in megahertz shows a reading of 3.525 MHz, it would show 3525 kHz if it were calibrated in kilohertz.
- T5B8 One microfarads is equal to 1,000,000 picofarads.
- T5B9 The approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts is 3dB. 3 dB gain is a double of power

dB	Power Change	
3 dB	2x	Power change
6 dB	4x	Power change
9 dB	8x	Power change
10 dB	10x	Power change
20 dB	100x	Power change
30 dB	1000x	Power change
40 dB	10,000x	Power change

Derivation:

If $\text{dB} = 10 \log_{10} \frac{P_1}{P_2}$

then what power ratio is 20 dB?

$$20 = 10 \log_{10} \frac{P_1}{P_2}$$

$$\frac{20}{10} = \log_{10} \frac{P_1}{P_2}$$

$$2 = \log_{10} \frac{P_1}{P_2}$$

Remember: logarithm of a number is the exponent to which the base must be raised to get the number.

$$\therefore 10^2 = \frac{P_1}{P_2}$$

$$100 = \frac{P_1}{P_2}$$

Or $P_1 = 100\ P_2$

20 dB means P_1 is 100 times P_2

- T5B10 The approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts is 6dB.
- T5B11 The approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts is 10 dB.

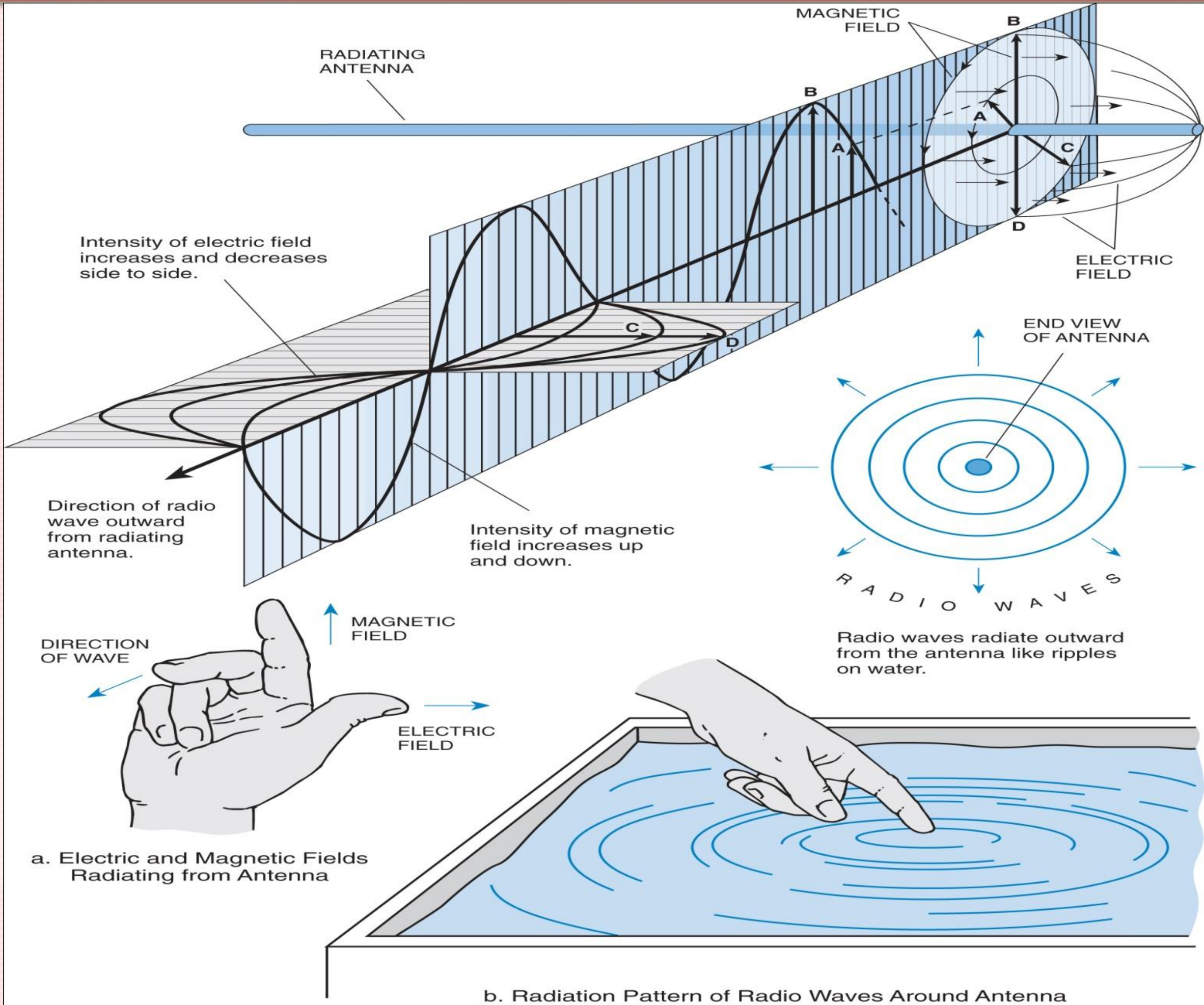
T5C: Electronic principles; capacitance, inductance, current flow in circuits, alternating current, definition of RF, power calculations

- T5C1 The ability to store energy in an electric field is called capacitance.
- T5C2 The basic unit of capacitance is the farad.
- T5C3 The ability to store energy in a magnetic field is called inductance.
- T5C4 The basic unit of inductance is the henry.
- T5C5 Hertz is the unit of frequency.

T5C: Electronic principles; capacitance, inductance, current flow in circuits, alternating current, definition of RF, power calculations

- T5C6 RF is the abbreviation that refers to **r**adio **f**requency signals of all types.

  - Term "RF" refers to **r**adio **f**requency

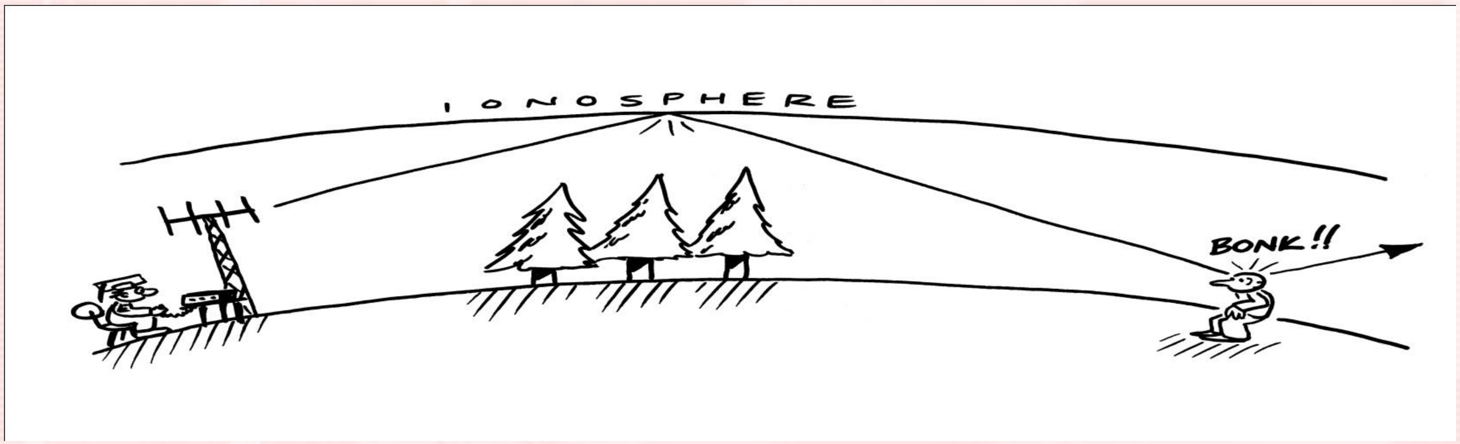


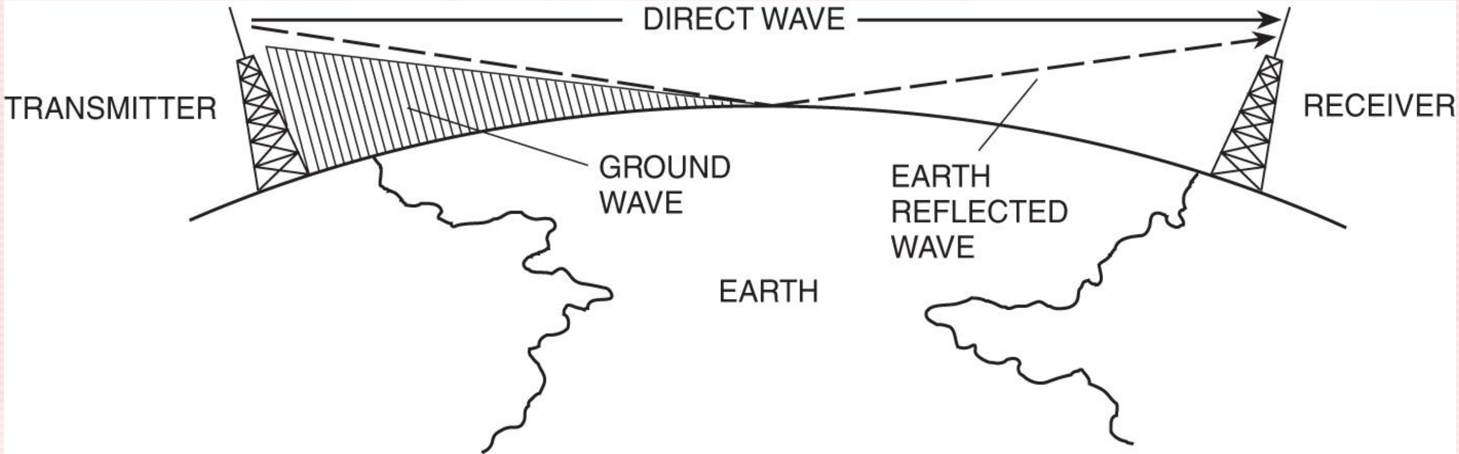
a. Electric and Magnetic Fields Radiating from Antenna

b. Radiation Pattern of Radio Waves Around Antenna

T5C: Electronic principles; capacitance, inductance, current flow in circuits, alternating current, definition of RF, power calculations

- T5C7 Radio waves is a usual name for electromagnetic waves that travel through space.
  - Electromagnetic waves are RADIO WAVES





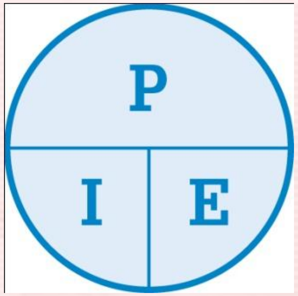
T5C: Electronic principles; capacitance, inductance, current flow in circuits, alternating current, definition of RF, power calculations

T5C8 Power (P) equals voltage (E) multiplied by current (I) is the formula used to calculate electrical power in a DC circuit.

- **P** is for power, **E** is for Voltage, and **I** is for current

The math is easy

Two known numbers are given, solve for the unknown



Cover up the unknown and plug the numbers in the other two

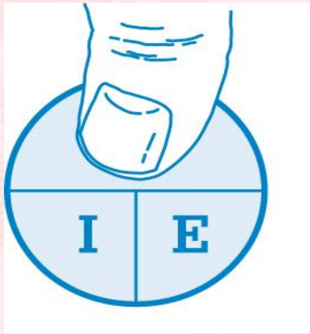
$P = I \times E$ Finding Power

$I = P / E$ Finding Amperes

$E = P / I$ Finding Voltage

T5C: Electronic principles; capacitance, inductance, current flow in circuits, alternating current, definition of RF, power calculations

- T5C9 138 watts of power is being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes.
  - Solving for "P" so cover up the P and plug in the other two numbers
  - **E** is given as 13.8 volts and **I** is given as 10 amperes

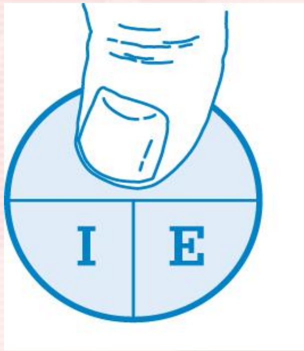


P = I x E

P = 10 x 13.8

P = 138 watts

- T5C10 30 watts of power is being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes.
  - Solving for "P" so cover up the "P" and plug in the other two numbers
  - **E** is given as 12 volts and **I** is given as 2.5 amperes

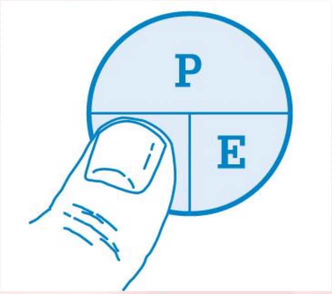


P = I x E

P = 2.5 x 12

P = 30 watts

- T5C11 10 amperes are flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts.
  - Solving for “I” so cover up the “I” and plug in the other two numbers
  - **P** is given as 120 watts and **E** is given as 12 volts and



I = P / E

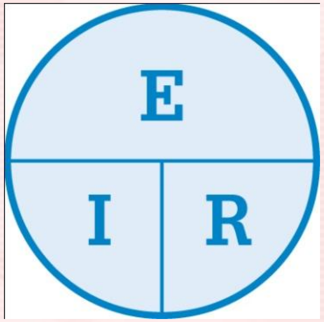
I = 120 / 12

I = 10 Amperes

- T5D1 The formula Current (I) equals voltage (E) divided by resistance (R) is used to calculate current in a circuit.
  - **E** is for Voltage, **I** is for current, and **R** is for resistance

The math is easy

Two known numbers are given, solve for the unknown



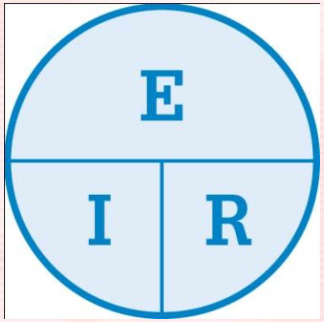
Cover up the unknown and plug the numbers in the other two

$I = E / R$	$E = I \times R$	$R = E / I$
Finding Amperes	Finding Voltage	Finding Resistance

- T5D2 The formula Voltage (E) equals current (I) multiplied by resistance (R) is used to calculate voltage in a circuit.
  - **E** is for Voltage, **I** is for current, and **R** is for resistance

The math is easy

Two known numbers are given, solve for the unknown



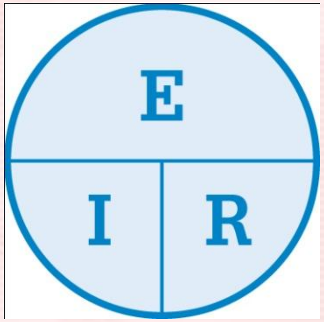
Cover up the unknown and plug the numbers in the other two

E = I x R	I = E / R	R= E / I
Finding Voltage	Finding Amperes	Finding Resistance

- T5D3 The formula Resistance (R) equals voltage (E) divided by current (I) is used to calculate resistance in a circuit.
  - **E** is for Voltage, **I** is for current, and **R** is for resistance

The math is easy

Two known numbers are given, solve for the unknown



Cover up the unknown and plug the numbers in the other two

R= E / I

Finding Resistance

I = E / R

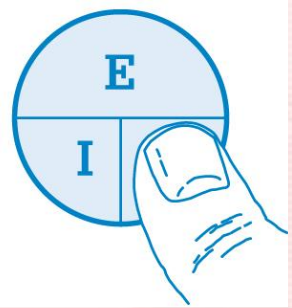
Finding Amperes

E = I x R

Finding Voltage

- T5D4 The resistance of a circuit in which a current of 3 amperes flows through a resistor connected to 90 volts is 30 ohms.

  - Solving for "R" so cover up the "R" and plug in the other two numbers
  - **E** is given as 90 volts and **I** is given as 3 amperes

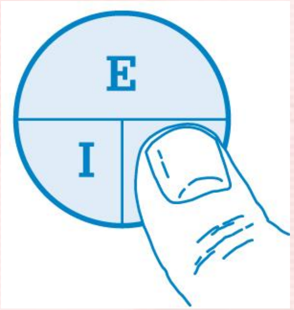


R = E / I

R = 90 / 3

R = 30 ohms

- T5D5 The resistance in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes is 8 ohms.
  - Solving for "R" so cover up the "R" and plug in the other two numbers
  - **E** is given as 12 volts and **I** is given as 1.5 amperes

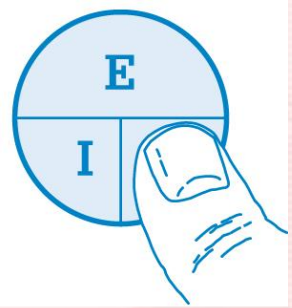


R = E / I

R = 12 / 1.5

R = 8 ohms

- T5D6 The resistance of a circuit that draws 4 amperes from a 12-volt source is 3 ohms.
  - Solving for "R" so cover up the "R" and plug in the other two numbers
  - **E** is given as 12 volts and **I** is given as 4 amperes



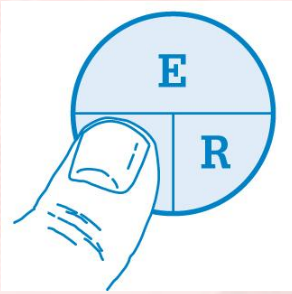
R = E / I

R = 12 / 4

R = 3 ohms

- T5D7 The current flow in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms is 1.5 amperes.

  - Solving for "I" so cover up the "I" and plug in the other two numbers
  - **E** is given as 120 volts and **R** is given as 80 ohms



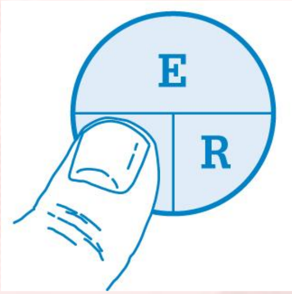
I = E / R

I = 120 / 80

I = 1.5 amperes

T5D Ohm's Law

- T5D8 The current flowing through a 100-ohm resistor connected across 200 volts 2 amperes.
  - Solving for "I" so cover up the "I" and plug in the other two numbers
  - **E** is given as 200 volts and **R** is given as 100 ohms

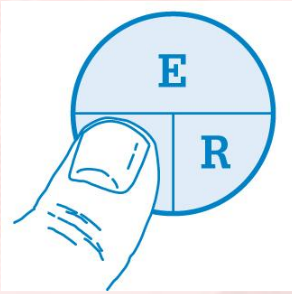


I = E / R

I = 200 / 100

I = 2 amperes

- T5D9 The current flowing through a 24-ohm resistor connected across 240 volts 10 amperes.
  - Solving for "I" so cover up the "I" and plug in the other two numbers
  - **E** is given as 240 volts and **R** is given as 24 ohms



I = E / R

I = 240 / 24

I = 10 amperes

- T5D10 The voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it is 1 volt.
  - Solving for "E" so cover up the "E" and plug in the other two numbers
  - **I** is given as 0.5 amperes and **R** is given as 2 ohms

E = I x R

E = 0.5 x 2

E= 1 volt

- T5D11 The voltage across a 10-ohm resistor if a current of 1 amperes flows through it is 10 volts.

  - Solving for "E" so cover up the "E" and plug in the other two numbers
  - **I** is given as 1 ampere and **R** is given as 10 ohms

E = I x R

E = 1 x 10

E= 10 volts

- T5D12 The voltage across a 10-ohm resistor if a current of 2 amperes flows through it is 20 volts.

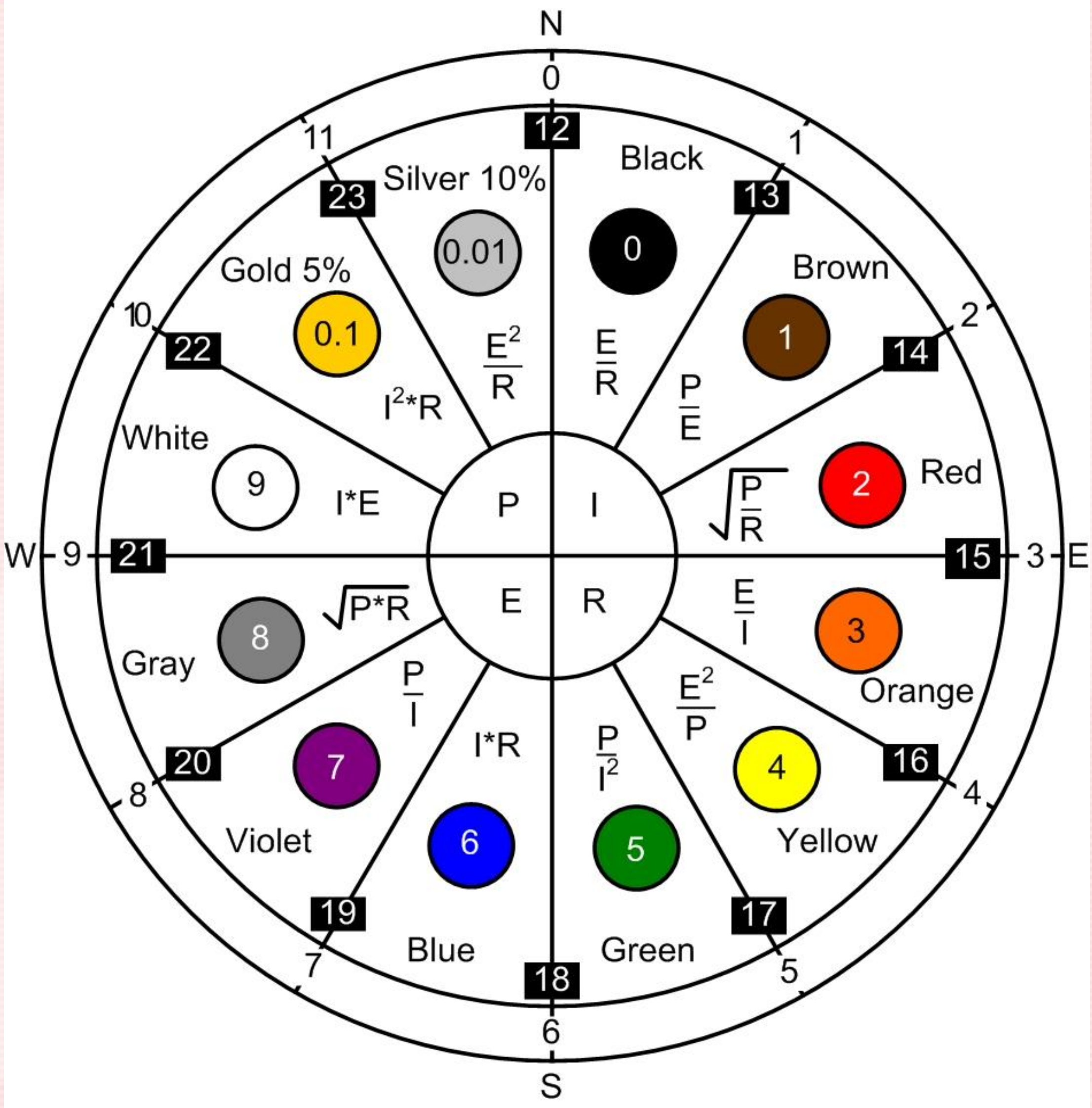
  - Solving for "E" so cover up the "E" and plug in the other two numbers
  - **I** is given as 1 ampere and **R** is given as 10 ohms

E = I x R

E = 2 x 10

E= 20 volts

T5D Ohm's Law

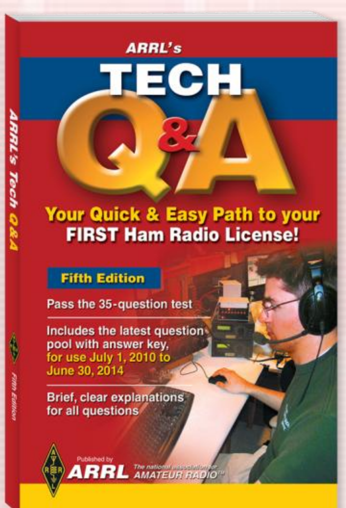


N
0
12
Black
0
1
13
11
Silver 10%
0.01
23
Gold 5%
0.1
10
22
Brown
1
2
14
E/R
P/E
E²/R
I²*R
White
9
I*E
P
I
√(P/R)
Red
2
W
9
21
15
3
E
E
R
√(P*R)
E/I
8
Gray
3
Orange
P/I
E²/P
20
7
I*R
P/I²
4
Yellow
16
4
8
Violet
6
5
19
Blue
Green
17
7
18
5
6
S

Element 2 Technician Class Question Pool

T5

Electrical principles, math for electronics, electronic principles, Ohm's Law
[4 Exam Questions – 4 Groups]



Valid July 1, 2010

Through

June 30, 2014

T5A01 Electrical current is measured in which of the following units?

A. Volts
B. Watts
C. Ohms
D. Amperes

T5A02 Electrical power is measured in which of the following units?

A. Volts
B. Watts
C. Ohms
D. Amperes

T5A03 What is the name for the flow of electrons in an electric circuit?

A. Voltage
B. Resistance
C. Capacitance
D. Current

T5A04 What is the name for a current that flows only in one direction?

A. Alternating current
B. Direct current
C. Normal current
D. Smooth current

T5A05 What is the electrical term for the electromotive force (EMF) that causes electron flow?

A. Voltage
B. Ampere-hours
C. Capacitance
D. Inductance

T5A06 How much voltage does a mobile transceiver usually require?

A. About 12 volts
B. About 30 volts
C. About 120 volts
D. About 240 volts

T5A07 Which of the following is a good electrical conductor?

A. Glass
B. Wood
C. Copper
D. Rubber

T5A08 Which of the following is a good electrical insulator?

A. Copper
B. Glass
C. Aluminum
D. Mercury

T5A09 What is the name for a current that reverses direction on a regular basis?

A. Alternating current
B. Direct current
C. Circular current
D. Vertical current

T5A10 Which term describes the rate at which electrical energy is used?

A. Resistance
B. Current
C. Power
D. Voltage

T5A11 What is the basic unit of electromotive force?

A. The volt
B. The watt
C. The ampere
D. The ohm

T5B01 How many milliamperes is 1.5 amperes?

A. 15 milliamperes
B. 150 milliamperes
C. 1,500 milliamperes
D. 15,000 milliamperes

T5B02 What is another way to specify a radio signal frequency of 1,500,000 hertz?

A. 1500 kHz
B. 1500 MHz
C. 15 GHz
D. 15 kHz

T5B03 How many volts are equal to one kilovolt?

A. One one-thousandth of a volt
B. One hundred volts
C. One thousand volts
D. One million volts

T5B04 How many volts are equal to one microvolt?

A. One one-millionth of a volt
B. One million volts
C. One thousand kilovolts
D. One one-thousandth of a volt

T5B05 Which of the following is equivalent to 500 milliwatts?

A. 0.02 watts
B. 0.5 watts
C. 5 watts
D. 50 watts

T5B06 If an ammeter calibrated in amperes is used to measure a 3000-milliampere current, what reading would it show?

A. 0.003 amperes
B. 0.3 amperes
C. 3 amperes
D. 3,000,000 amperes

T5B07

If a frequency readout calibrated in megahertz shows a reading of 3.525 MHz, what would it show if it were calibrated in kilohertz?

A. 0.003525 kHz
B. 35.25 kHz
C. 3525 kHz
D. 3,525,000 kHz

T5B08 How many microfarads are 1,000,000 picofarads?

A. 0.001 microfarads
B. 1 microfarad
C. 1000 microfarads
D. 1,000,000,000 microfarads

T5B09 What is the approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts?

A. 2 dB
B. 3 dB
C. 5 dB
D. 10 dB

T5B10 What is the approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts?

A. 1 dB
B. 3 dB
C. 6 dB
D. 9 dB

T5B11 What is the approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts?

A. 10 dB

B. 12 dB

C. 18 dB

D. 28 dB

T5C01 What is the ability to store energy in an electric field called?

A. Inductance
B. Resistance
C. Tolerance
D. Capacitance

T5C02 What is the basic unit of capacitance?

A. The farad
B. The ohm
C. The volt
D. The henry

T5C03 What is the ability to store energy in a magnetic field called?

A. Admittance
B. Capacitance
C. Resistance
D. Inductance

T5C04 What is the basic unit of inductance?

A. The coulomb
B. The farad
C. The henry
D. The ohm

T5C05 What is the unit of frequency?

A. Hertz
B. Henry
C. Farad
D. Tesla

T5C06 What is the abbreviation that refers to radio frequency signals of all types?

A. AF
B. HF
C. RF
D. VHF

T5C07 What is a usual name for electromagnetic waves that travel through space?

A. Gravity waves
B. Sound waves
C. Radio waves
D. Pressure waves

T5C08 What is the formula used to calculate electrical power in a DC circuit?

A. Power (P) equals voltage (E) multiplied by current (I)
B. Power (P) equals voltage (E) divided by current (I)
C. Power (P) equals voltage (E) minus current (I)
D. Power (P) equals voltage (E) plus current (I)

T5C09 How much power is being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes?

A. 138 watts
B. 0.7 watts
C. 23.8 watts
D. 3.8 watts

T5C10 How much power is being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes?

A. 4.8 watts
B. 30 watts
C. 14.5 watts
D. 0.208 watts

T5C11 How many amperes are flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts?

A. 0.1 amperes
B. 10 amperes
C. 12 amperes
D. 132 amperes

T5D01 What formula is used to calculate current in a circuit?

A. Current (I) equals voltage (E) multiplied by resistance (R)
B. Current (I) equals voltage (E) divided by resistance (R)
C. Current (I) equals voltage (E) added to resistance (R)
D. Current (I) equals voltage (E) minus resistance (R)

T5D02 What formula is used to calculate voltage in a circuit?

A. Voltage (E) equals current (I) multiplied by resistance (R)
B. Voltage (E) equals current (I) divided by resistance (R)
C. Voltage (E) equals current (I) added to resistance (R)
D. Voltage (E) equals current (I) minus resistance (R)

T5D03 What formula is used to calculate resistance in a circuit?

A. Resistance (R) equals voltage (E) multiplied by current (I)
B. Resistance (R) equals voltage (E) divided by current (I)
C. Resistance (R) equals voltage (E) added to current (I)
D. Resistance (R) equals voltage (E) minus current (I)

T5D04 What is the resistance of a circuit in which a current of 3 amperes flows through a resistor connected to 90 volts?

A. 3 ohms
B. 30 ohms
C. 93 ohms
D. 270 ohms

T5D05 What is the resistance in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes?

A. 18 ohms
B. 0.125 ohms
C. 8 ohms
D. 13.5 ohms

T5D06 What is the resistance of a circuit that draws 4 amperes from a 12-volt source?

A. 3 ohms
B. 16 ohms
C. 48 ohms
D. 8 ohms

T5D07 What is the current flow in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms?

A. 9600 amperes
B. 200 amperes
C. 0.667 amperes
D. 1.5 amperes

T5D08 What is the current flowing through a 100-ohm resistor connected across 200 volts?

A. 20,000 amperes
B. 0.5 amperes
C. 2 amperes
D. 100 amperes

T5D09 What is the current flowing through a 24-ohm resistor connected across 240 volts?

A. 24,000 amperes
B. 0.1 amperes
C. 10 amperes
D. 216 amperes

T5D10 What is the voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it?

A. 1 volt
B. 0.25 volts
C. 2.5 volts
D. 1.5 volts

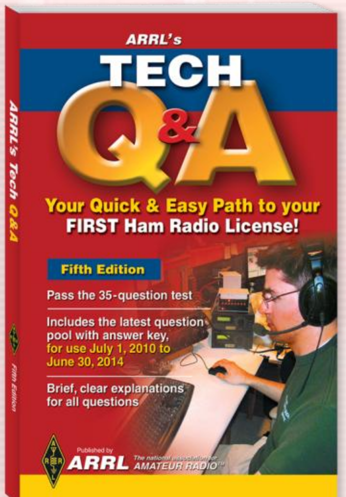
T5D11 What is the voltage across a 10-ohm resistor if a current of 1 ampere flows through it?

A. 1 volt
B. 10 volts
C. 11 volts
D. 9 volts

T5D12 What is the voltage across a 10-ohm resistor if a current of 2 amperes flows through it?

A. 8 volts
B. 0.2 volts
C. 12 volts
D. 20 volts

Technician Licensing Class
“T6”



Valid dates:

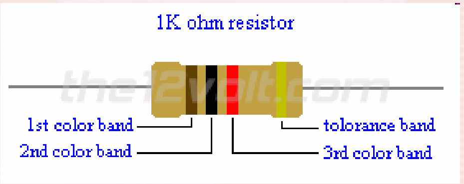
July 1, 2010 – June 30, 2014

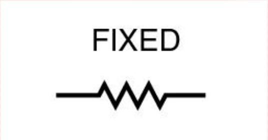
Amateur Radio Technician Class
Element 2 Course Presentation

- **ELEMENT 2 SUB-ELEMENTS**
  - **T1 - FCC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities.**
  - **T2 – Operating Procedures**
  - **T3 – Radio wave characteristics, radio and electromagnetic properties, propagation modes**
  - **T4 – Amateur radio practices and station set up**
  - **T5 – Electrical principles, math for electronics, electronic principles, Ohm's Law**
  - **T6 – Electrical components, semiconductors, circuit diagrams, component functions**
  - **T7 – Station equipment, common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing**
  - **T8 – Modulation modes, amateur satellite operation, operating activities, non-voice communications**
  - **T9 – Antennas, feedlines**
  - **T0 – AC power circuits, antenna installation, RF hazards**

T6A: Electrical components; fixed and variable resistors, capacitors, and inductors; fuses, switches, batteries

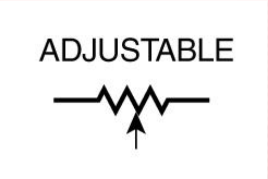
- T6A1 A resistor is the electrical component used to oppose the flow of current in a DC circuit.





Schematic Symbol

- T6A2 The potentiometer is the type of component often used as an adjustable volume control.

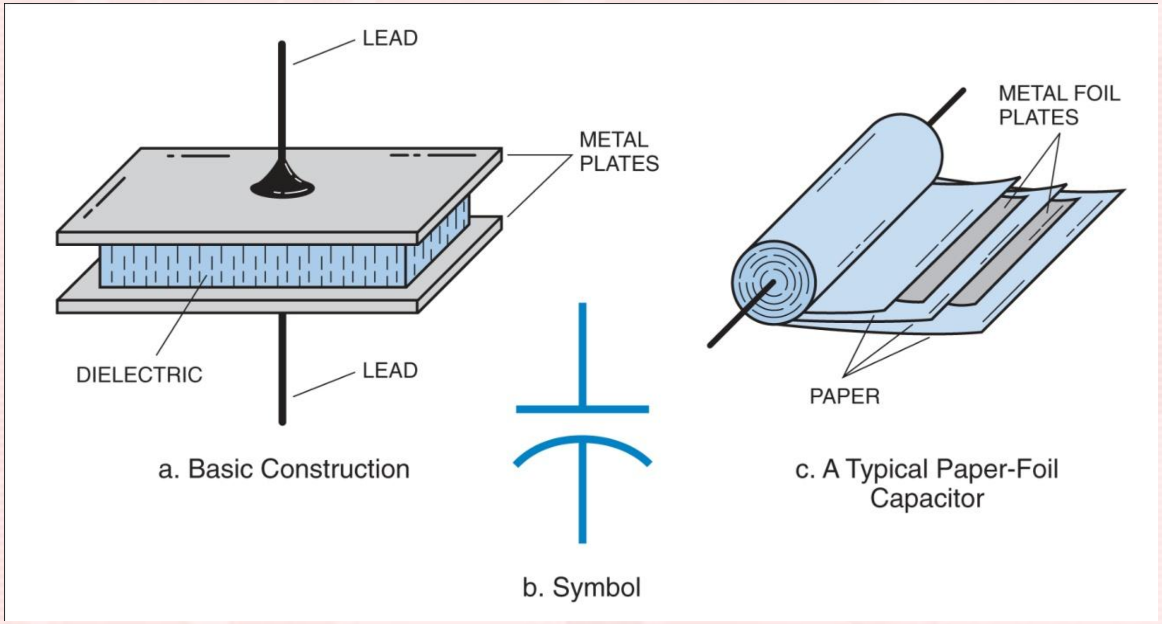


Schematic Symbol

- T6A3 Resistance is the electrical parameter controlled by a potentiometer.

T6A: Electrical components; fixed and variable resistors, capacitors, and inductors; fuses, switches, batteries

T6A4 A capacitor is the electrical component that stores energy in an electric field.

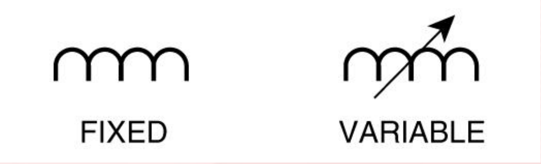


Typical construction and schematic symbol for capacitors.

Various fixed capacitors

T6A: Electrical components; fixed and variable resistors, capacitors, and inductors; fuses, switches, batteries

- T6A5 The capacitor is the type of electrical component consisting of two or more conductive surfaces separated by an insulator.
  - Paper, mica, air…
- T6A6 An inductor is the type of electrical component that stores energy in a magnetic field.
- T6A7 The inductor is an electrical component usually composed of a coil of wire.

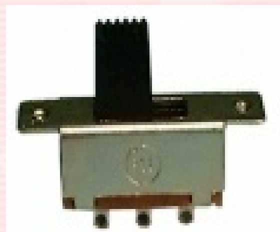


Schematic Symbol

T6A: Electrical components; fixed and variable resistors, capacitors, and inductors; fuses, switches, batteries

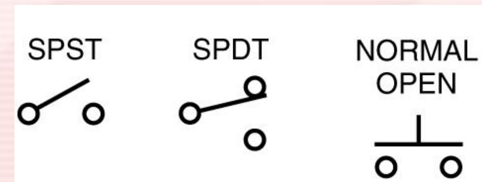
- T6A8 A switch is an electrical component that is used to connect or disconnect electrical circuits.

Toggle Switch



Slide Switch

Rocker Switch



Schematic Symbol

- T6A9 A fuse is an electrical component used to protect other circuit components from current overloads.

Slow Blow Fuse

Automobile Fuse

Schematic Symbol

T6A: Electrical components; fixed and variable resistors, capacitors, and inductors; fuses, switches, batteries

- T6A10 1.2 volts is the nominal voltage of a fully charged nickel-cadmium cell.

Small and compact just like Ham Radio hand helds.

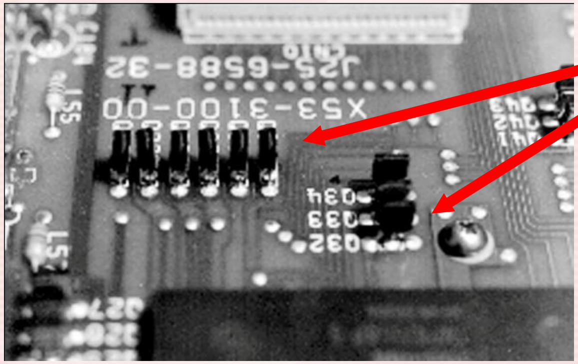
Ni-Cad rechargeable 1.25 volt batteries in a marine hand held.

Rubber duck antenna

- T6A11 A carbon-zinc battery type is not rechargeable.

T6B: Semiconductors; basic principles of diodes and transistors

- T6B1 Transistors are a class of electronic components capable of using a voltage or current signal to control current flow.

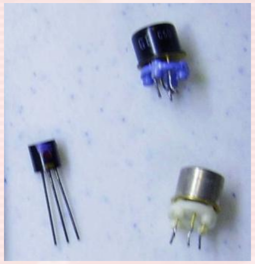


Rows of Transistors

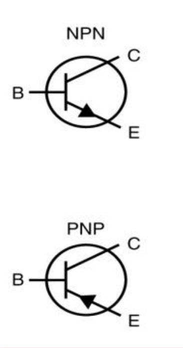
- T6B2 A diode is an electronic component that allows current to flow in only one direction.
  - Rectification is process of changing AC to pulsating DC
  - Diode stops current flow when it tries to go in the reverse direction

T6B: Semiconductors; basic principles of diodes and transistors

- T6B3 A transistor is a component that can be used as an electronic switch or amplifier.

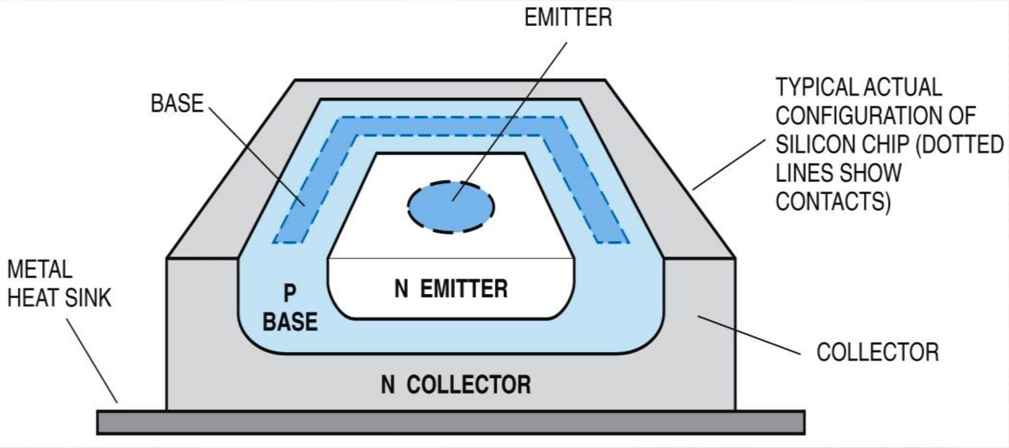


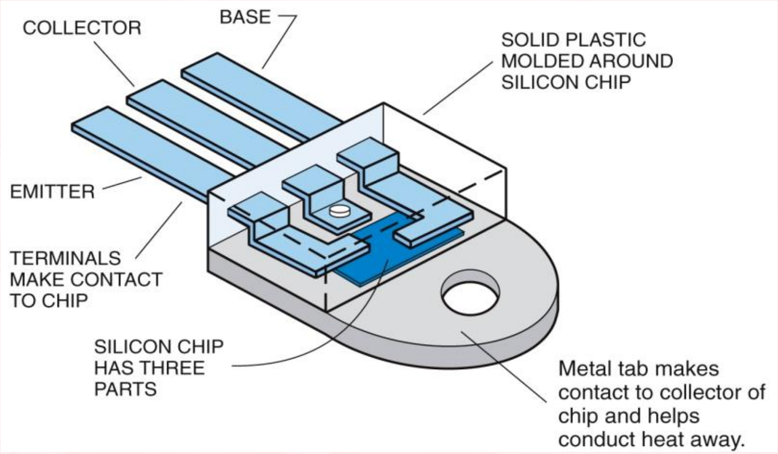
Small Signal Transistors



Schematic Symbol

- T6B4 The bipolar junction transistor is a component that is made of three layers of semiconductor material.

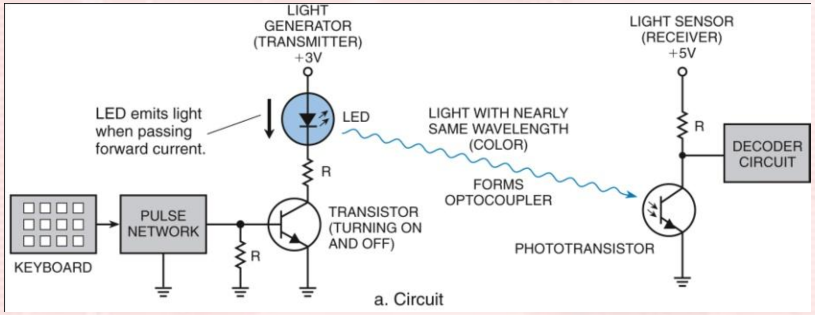




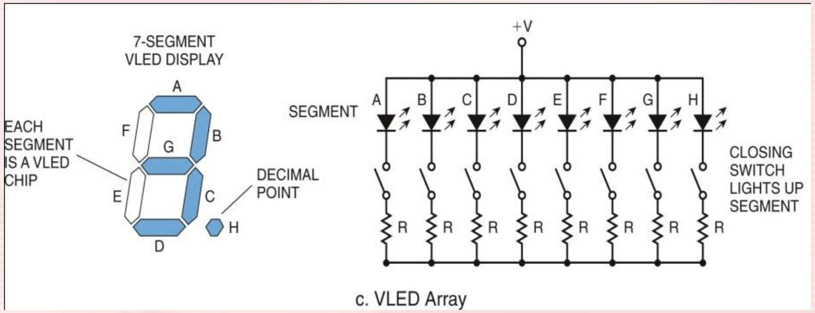
T6B: Semiconductors; basic principles of diodes and transistors

- T6B5 The transistor is an electronic components that can amplify signals.
- T6B6 A semiconductor diode’s cathode lead is usually identified with a stripe.

- T6B7 The abbreviation "LED" stands for **L**ight **E**mitting **D**iode.



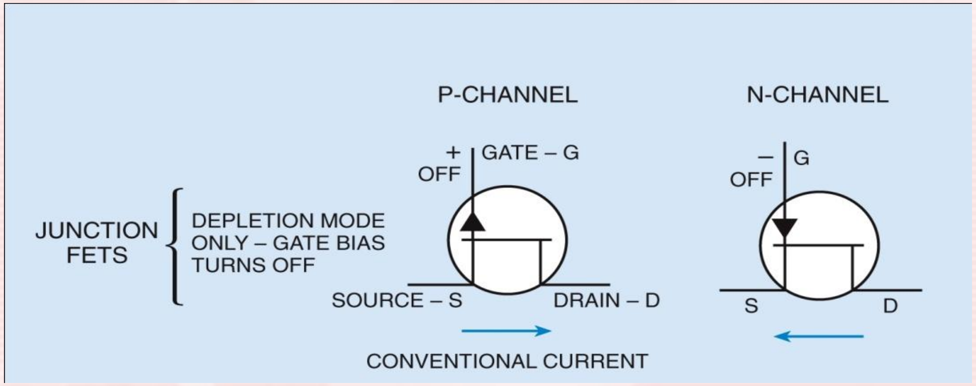
a. Circuit



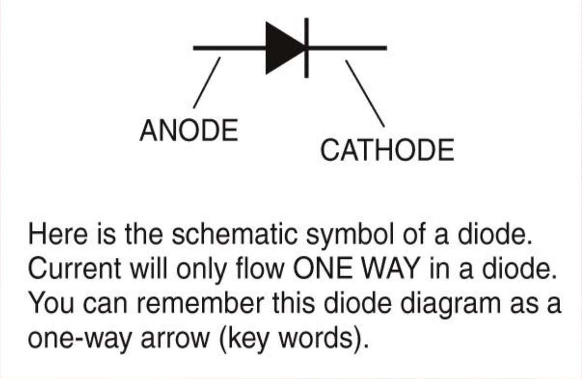
c. VLED Array

T6B: Semiconductors; basic principles of diodes and transistors

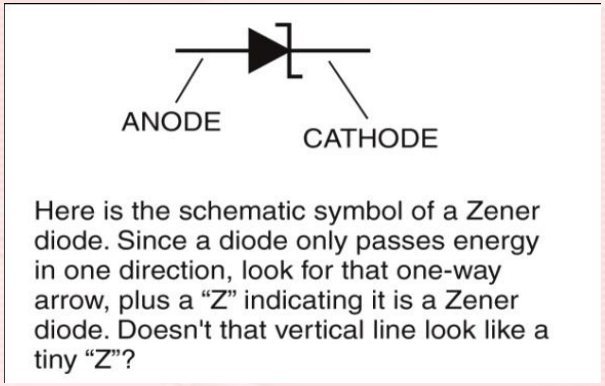
- T6B8 The abbreviation "FET" stands for **F**ield **E**ffect **T**ransistor.



- T6B9 Anode and cathode are the names of the two electrodes of a diode.



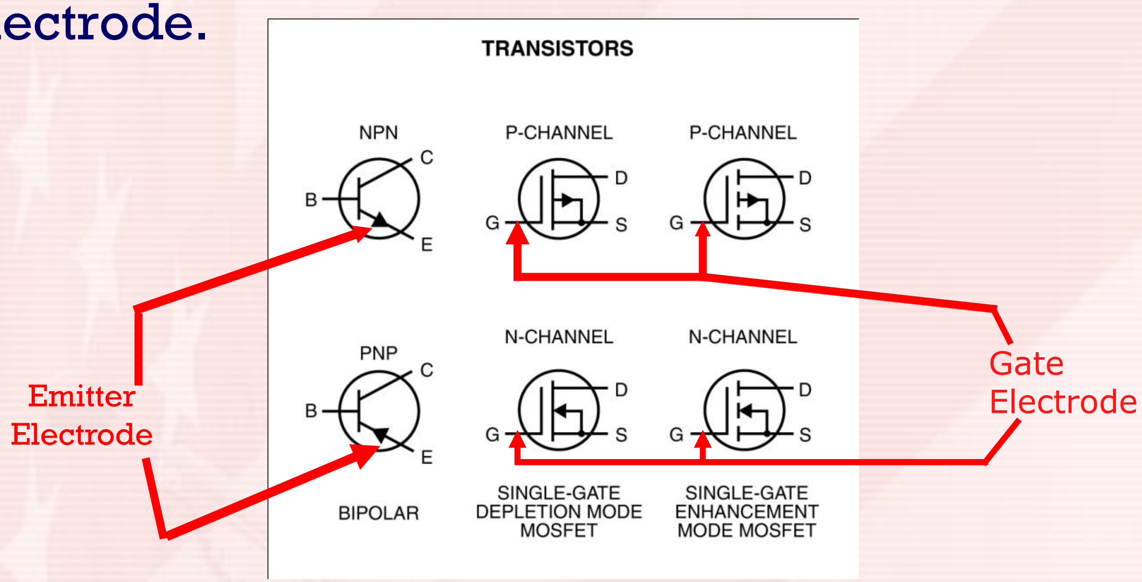
Semiconductor Diode



Zener Diode

T6B: Semiconductors; basic principles of diodes and transistors

- T6B10 The bipolar transistor semiconductor component has an emitter electrode.

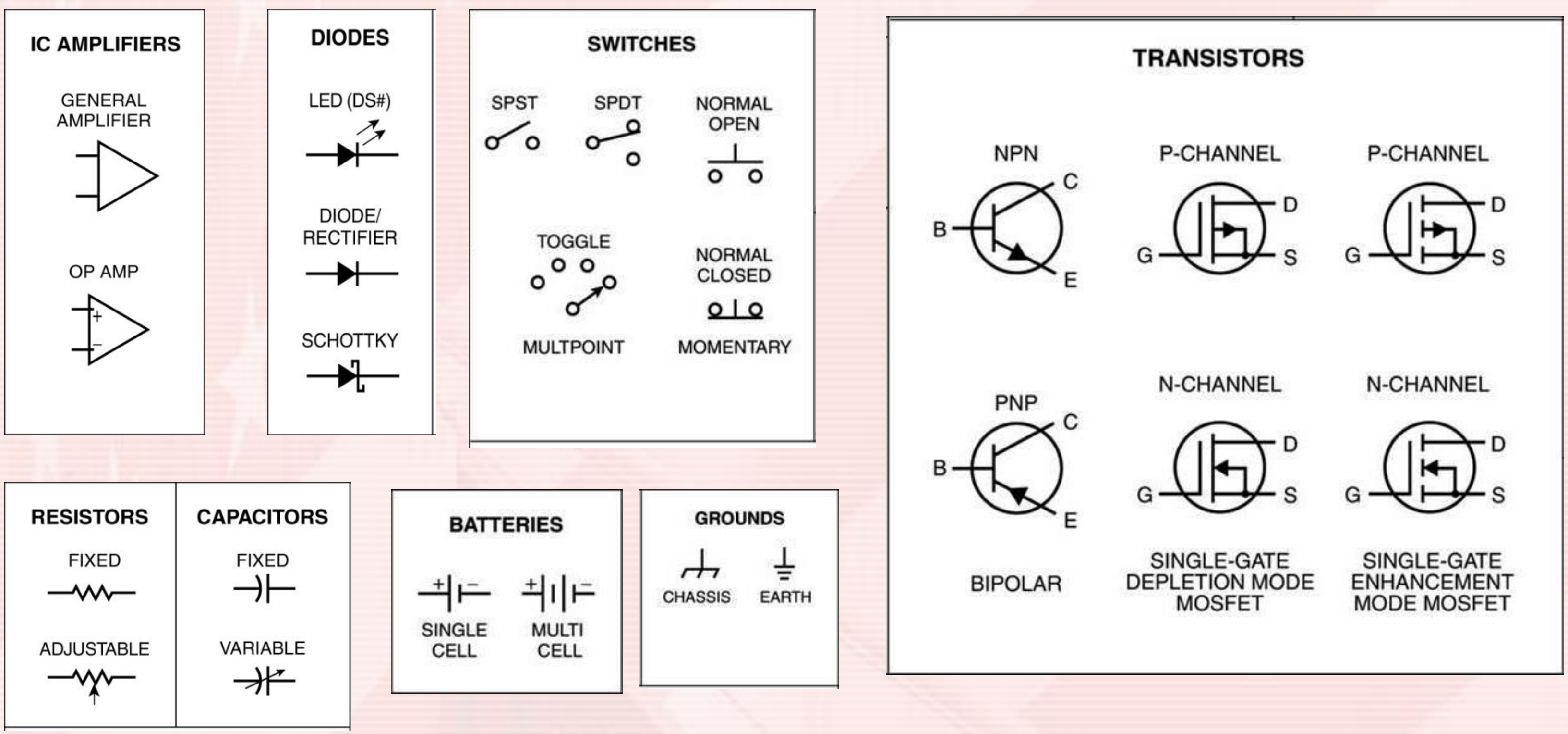


- T6B11 The field effect transistor semiconductor component has a gate electrode.

- T6B12 Gain is the term that describes a transistor's ability to amplify a signal.

T6C: Circuit diagrams; schematic symbols

- T6C1 Schematic symbols is the name for standardized representations of components in an electrical wiring diagram.



T6C: Circuit diagrams; schematic symbols

T6C2 Component 1 in figure T1 is a resistor.

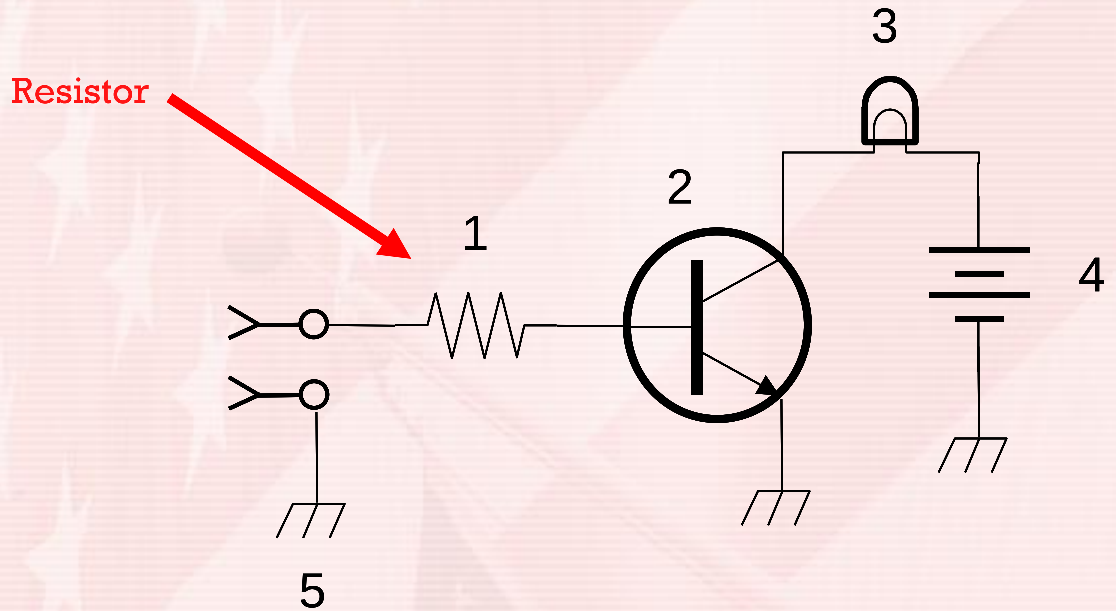


Figure T1

T6C: Circuit diagrams; schematic symbols

- T6C3 Component 2 in figure T1 is a transistor.

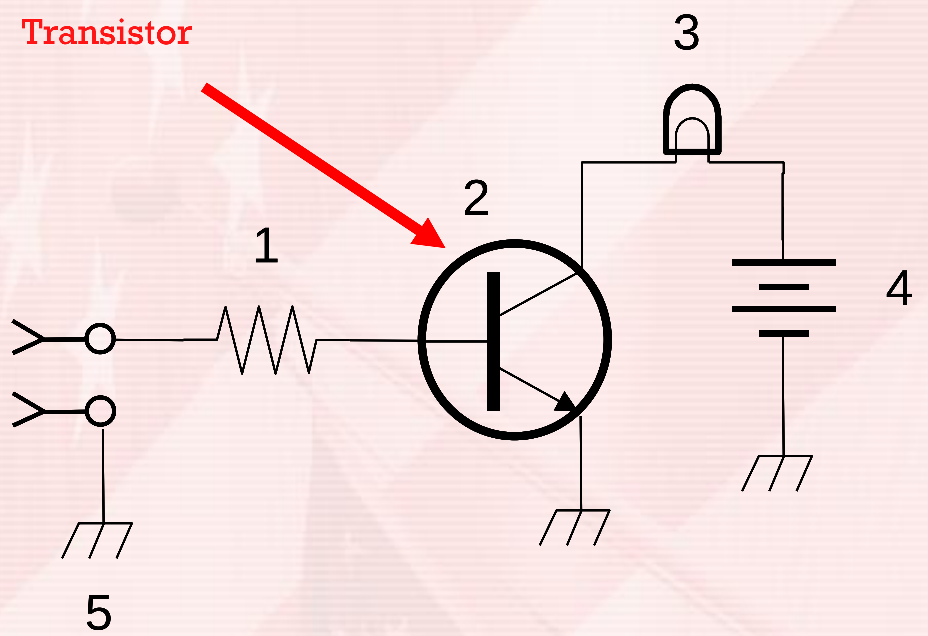


Figure T1

T6C: Circuit diagrams; schematic symbols

- T6C4 Component 3 in figure T1 is a lamp.

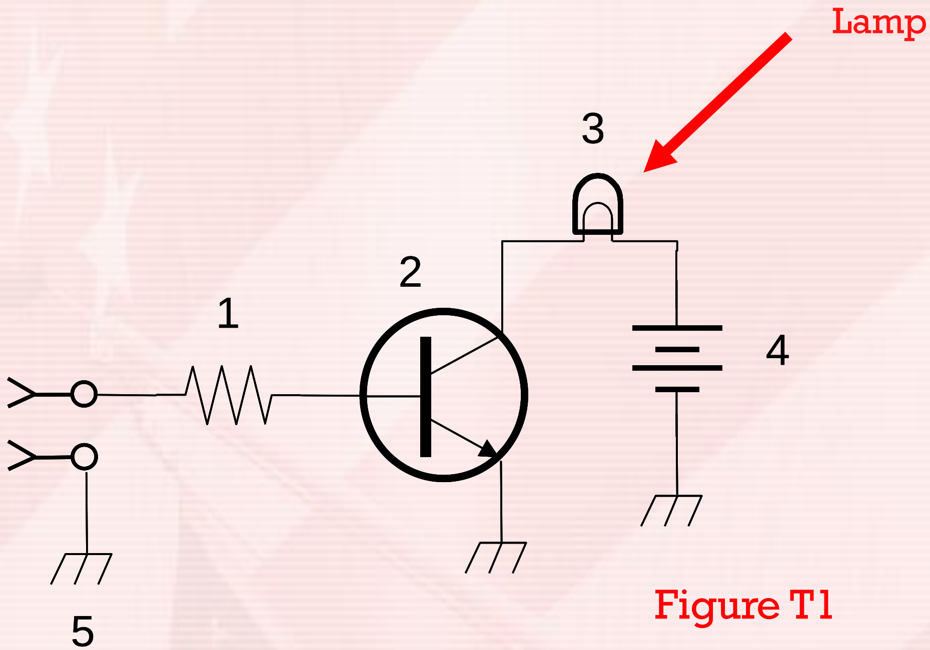


Figure T1

T6C: Circuit diagrams; schematic symbols

- T6C5 Component 4 in figure T1 is a battery.

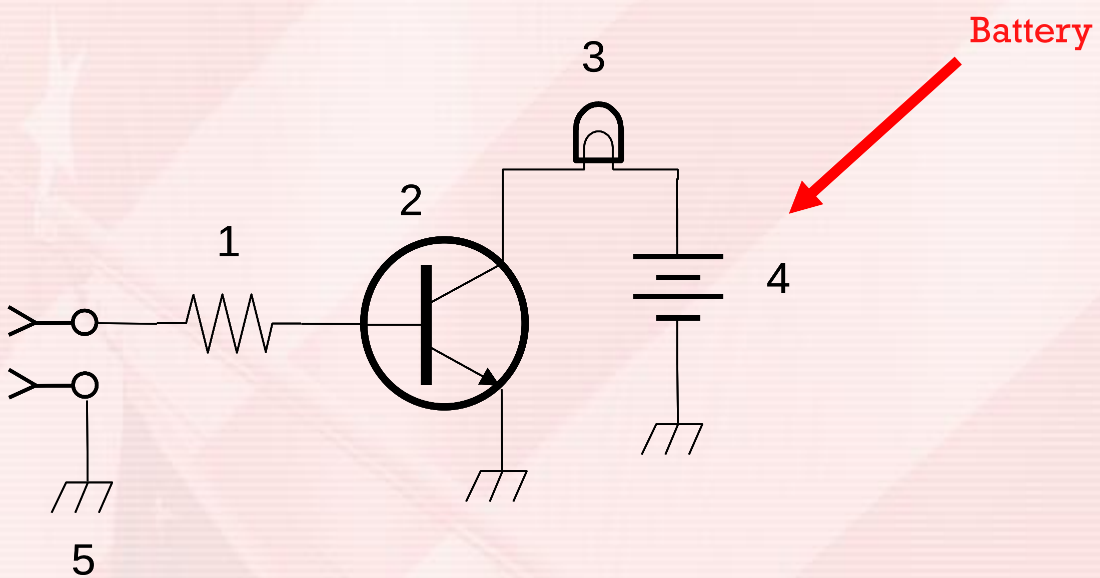


Figure T1

T6C: Circuit diagrams; schematic symbols

- T6C6 Component 6 in figure T2 is a capacitor.

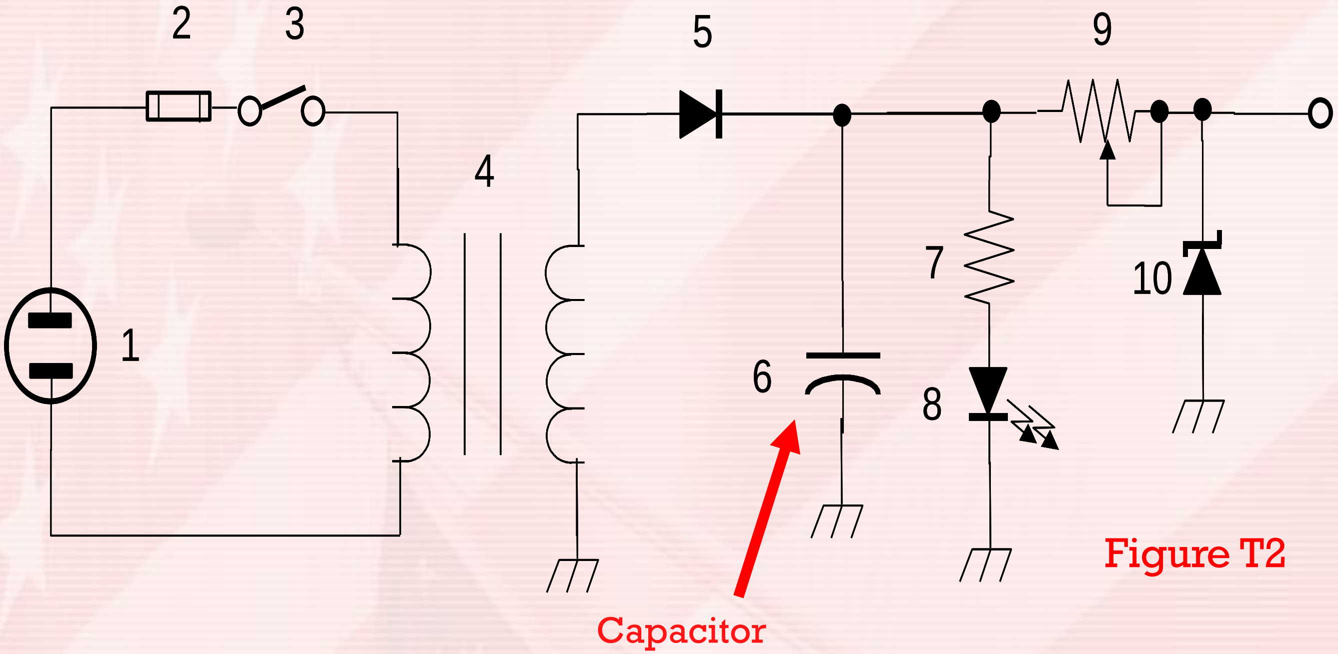


Figure T2

T6C: Circuit diagrams; schematic symbols

- T6C7 Component 8 in figure T2 is a light emitting diode.

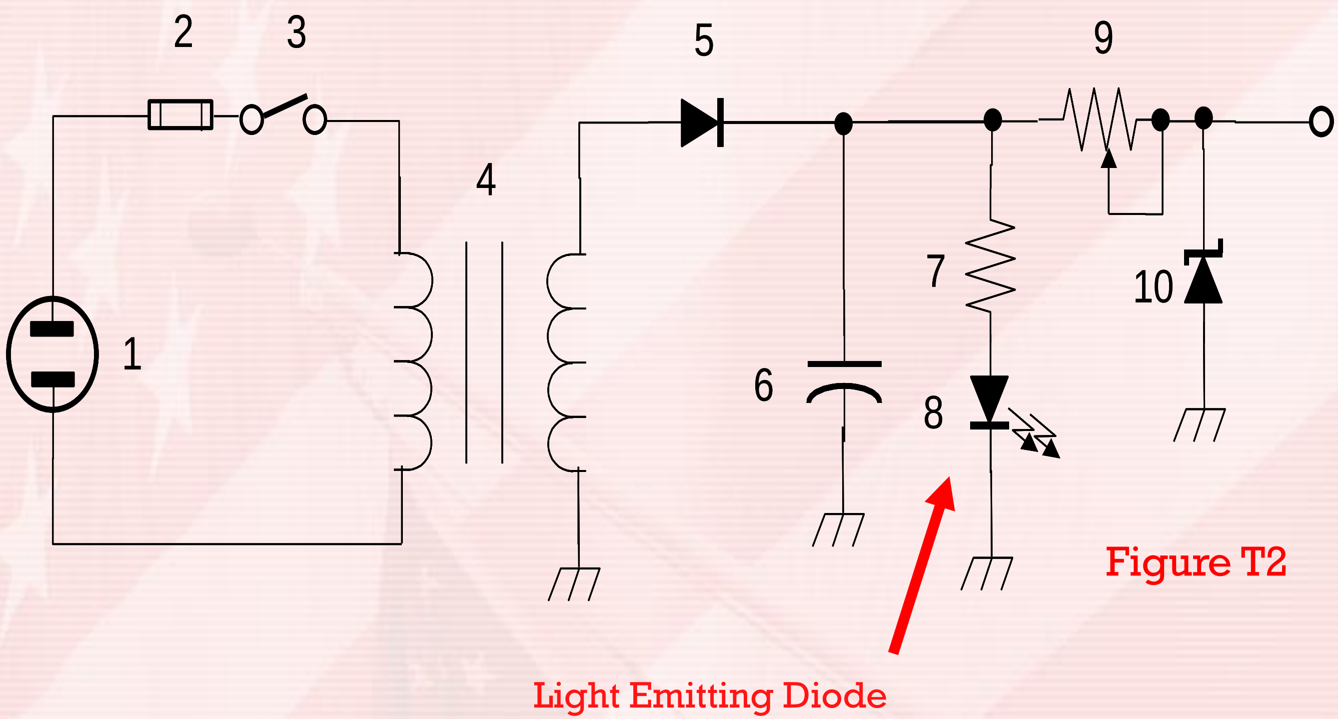


Figure T2

- T6C8 Component 9 in figure T2 is a variable resistor.

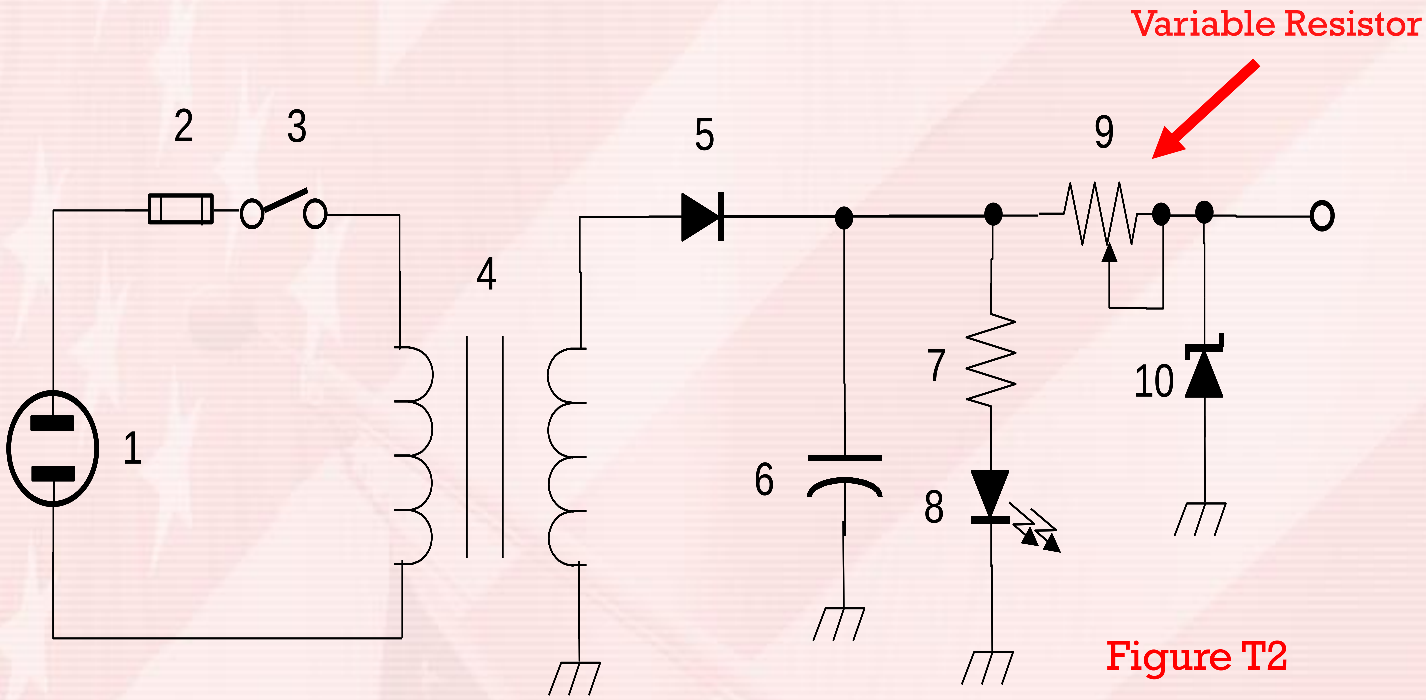


Figure T2

- T6C9 Component 4 in figure T2 is a transformer.

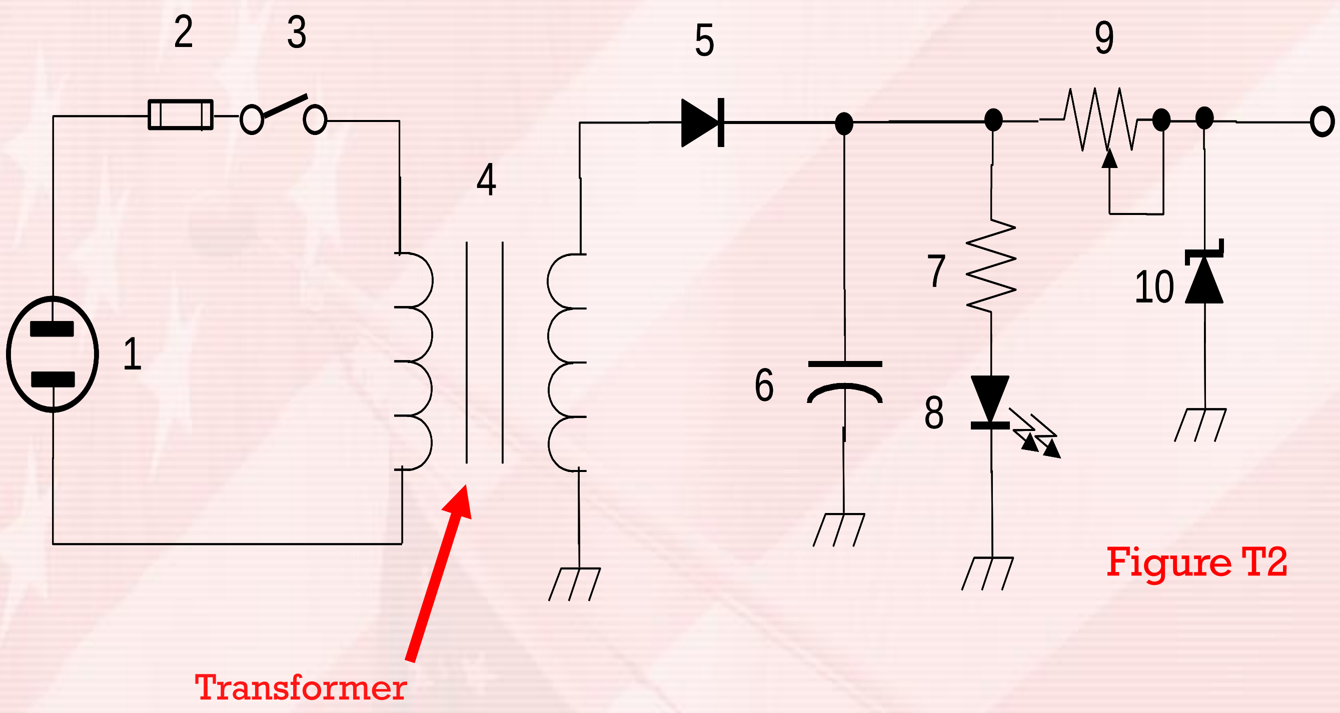


Figure T2

T6C: Circuit diagrams; schematic symbols

- T6C10 Component 3 in figure T3 is a variable inductor.

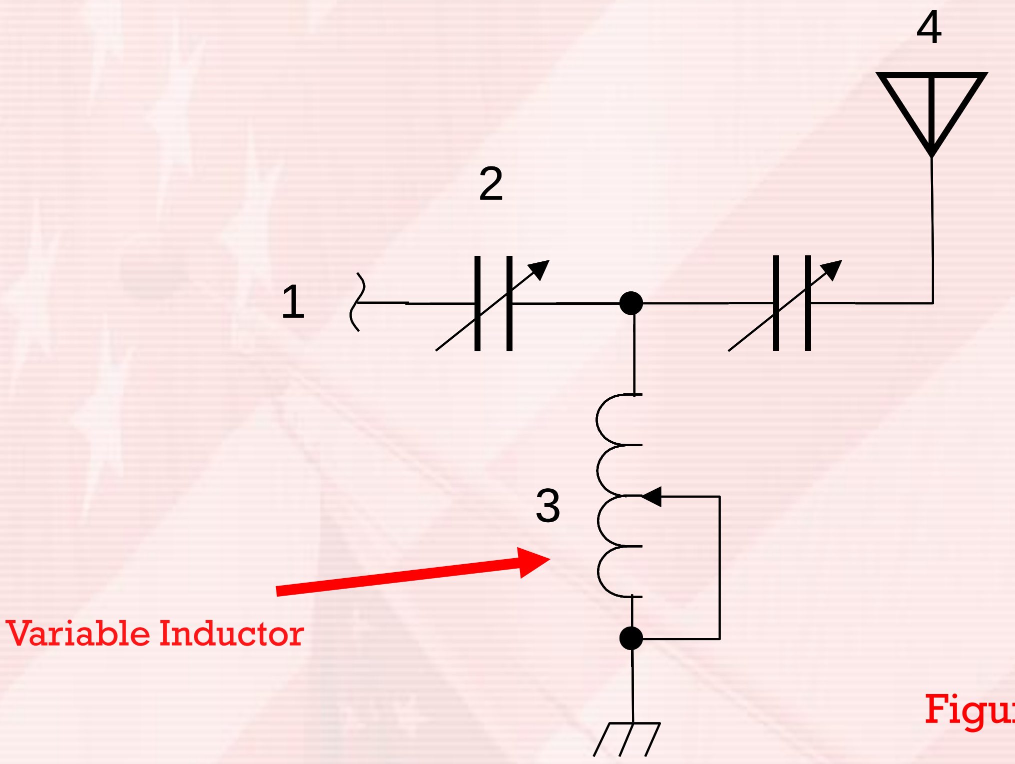


Figure T3

T6C: Circuit diagrams; schematic symbols

- T6C11 Component 4 in figure T3 is an antenna.

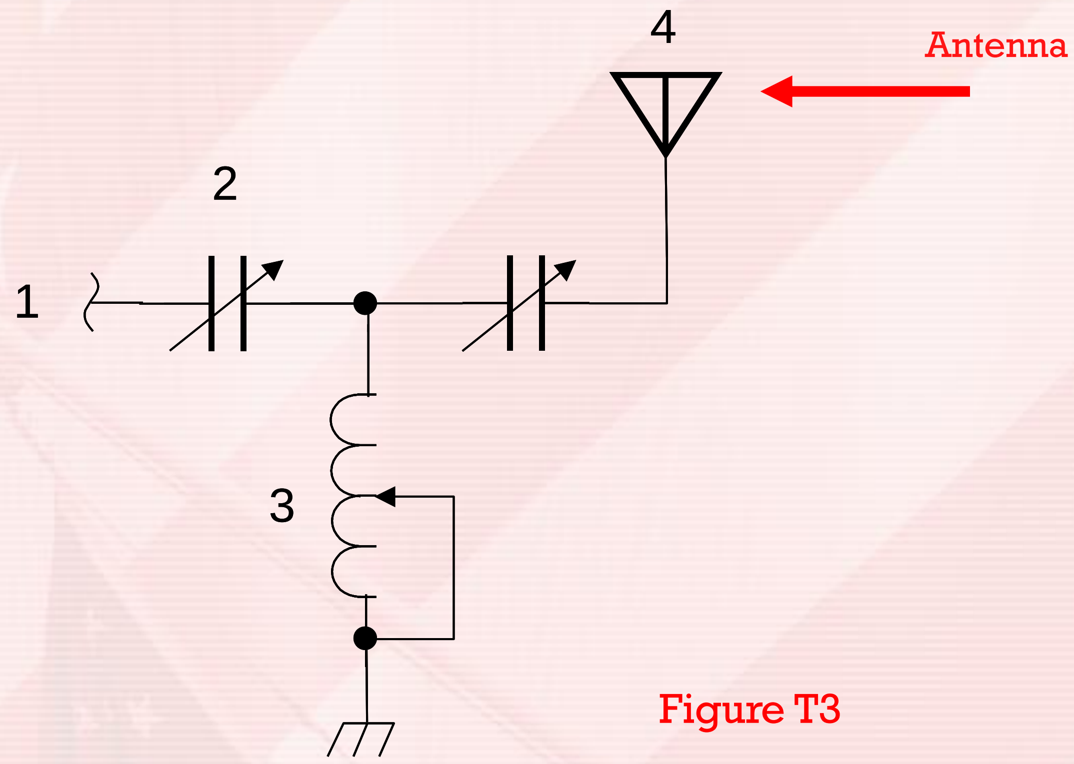
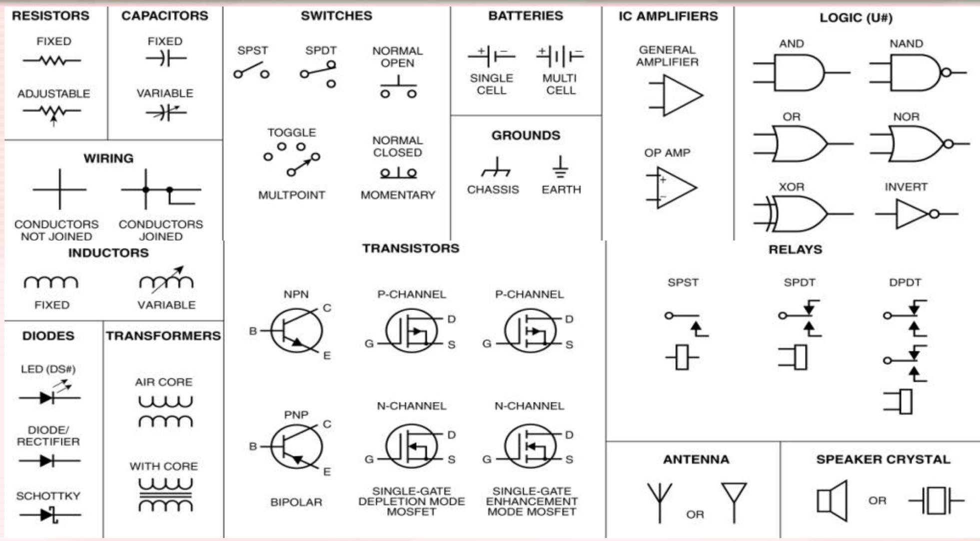


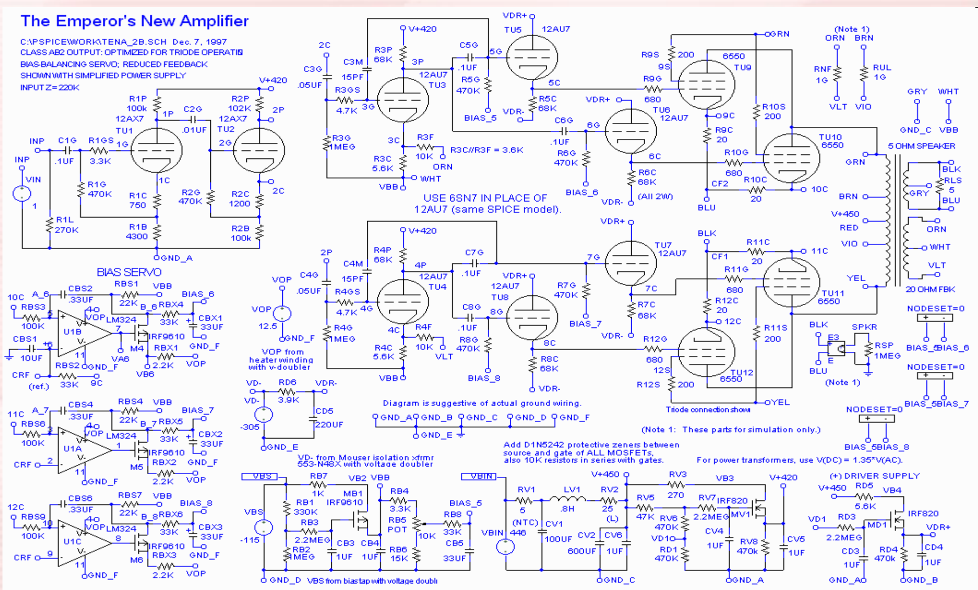
Figure T3

T6C: Circuit diagrams; schematic symbols

- T6C12 The symbols on an electrical circuit schematic diagram represent electrical components.

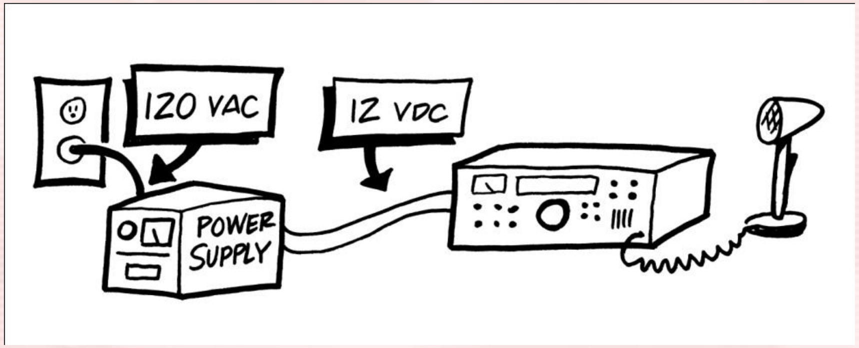
- T6C13 The way electrical components are interconnected accurately represent electrical circuit schematic diagrams.





T6D: Component functions

- T6D1 Rectifier devices or circuits change an alternating current into a varying direct current signal.

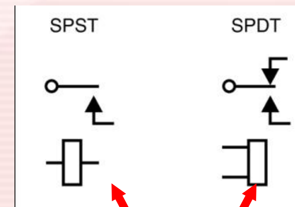


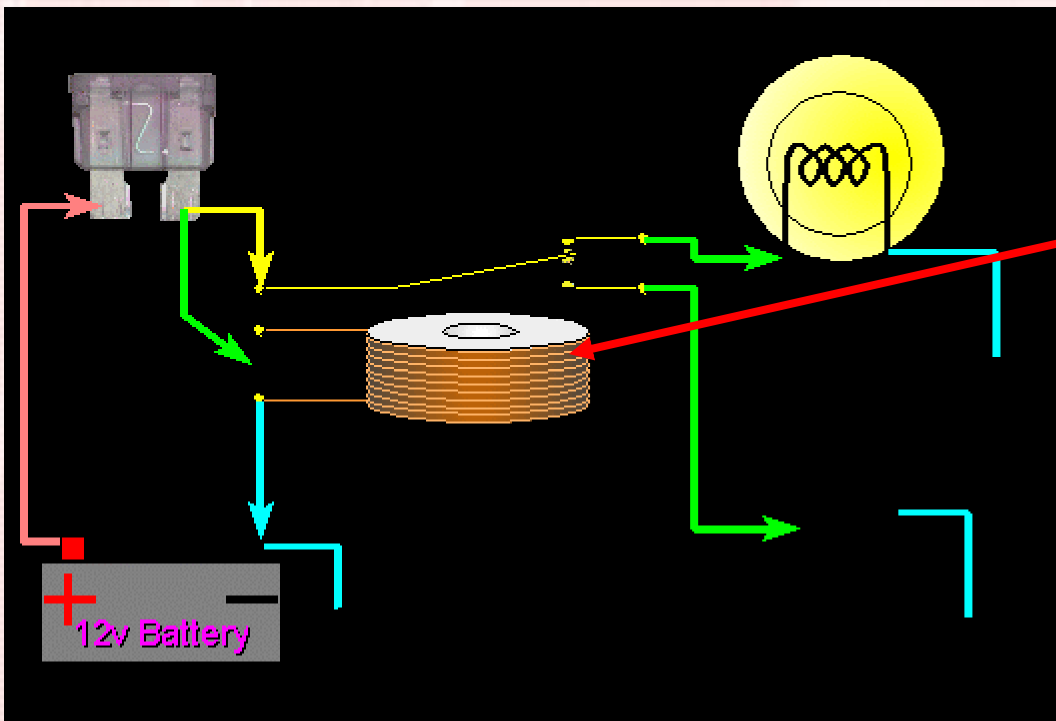
Power supply contains: Transformer, rectifier (diodes), filter choke, capacitors, and regulators.

This circuitry converts the house 120 VAC to varying DC and that is filtered and smoothed out to produce DC current that we need for our ham radio equipment.

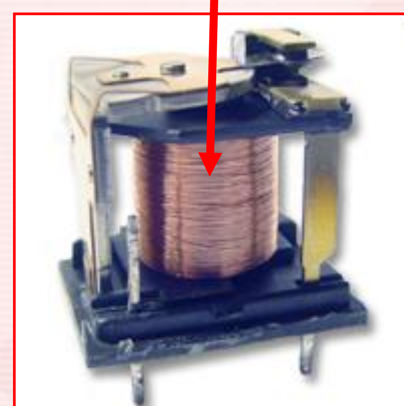
T6D2 A switch controlled by an electromagnet best describes a relay.

Relays





Electromagnets



T6D: Component functions

- T6D3 A single-pole single-throw switch is represented by item 3 in figure T2.

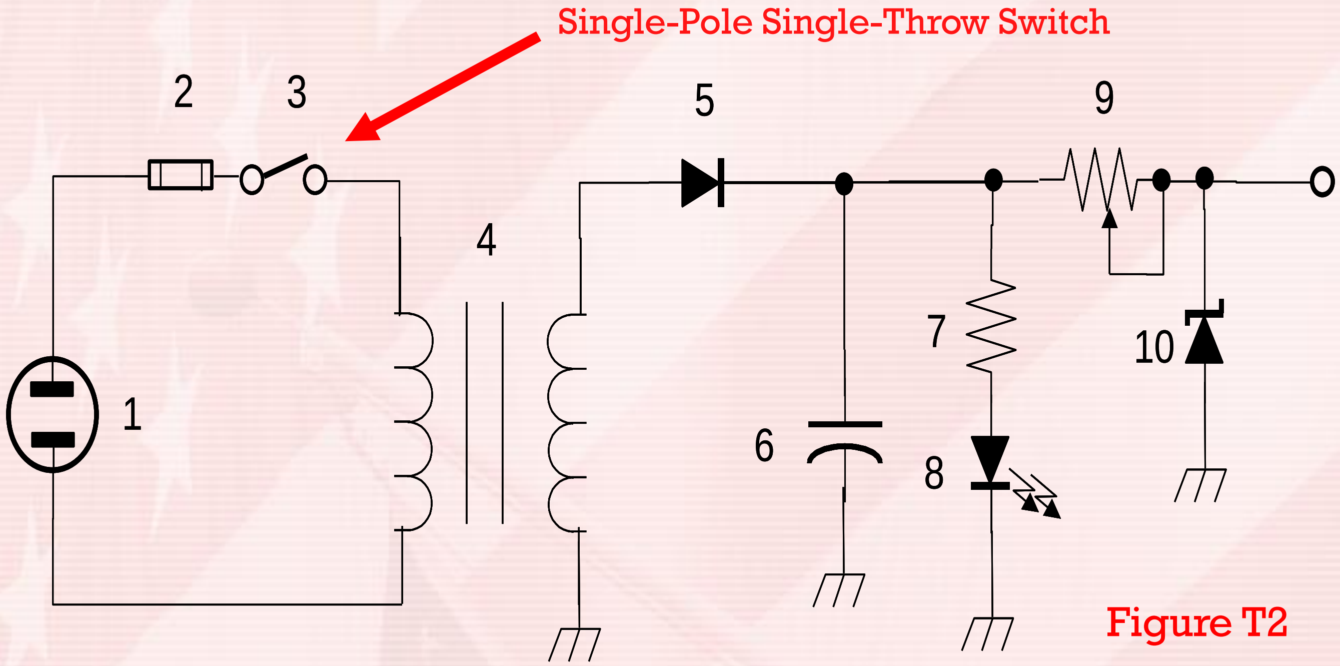


Figure T2

T6D: Component functions

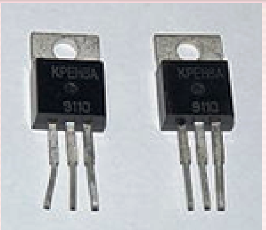
- T6D4 A meter can be used to display signal strength on a numeric scale.

S-Meter

Icom 7700

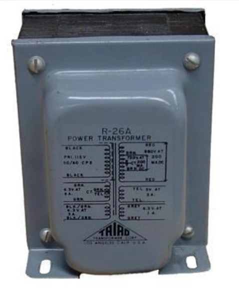
T6D: Component functions

- T6D5 A regulator is a type of circuit that controls the amount of voltage from a power supply.



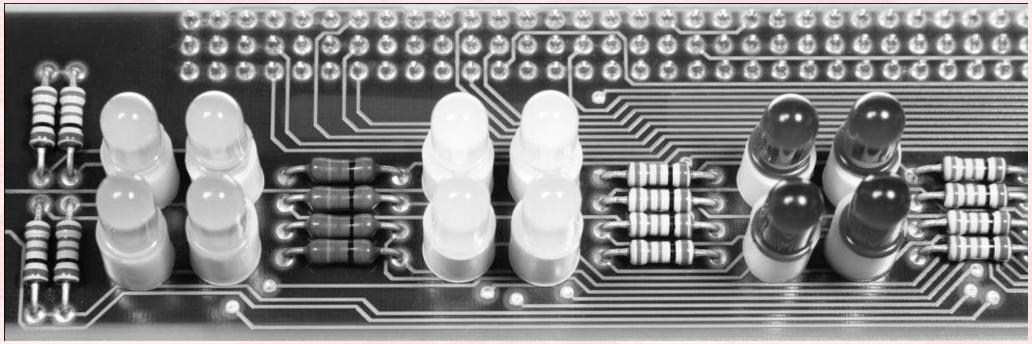
Voltage Regulators

- T6D6 A transformer is a component commonly used to change 120V AC house current to a lower AC voltage for other uses.



Voltage Transformer

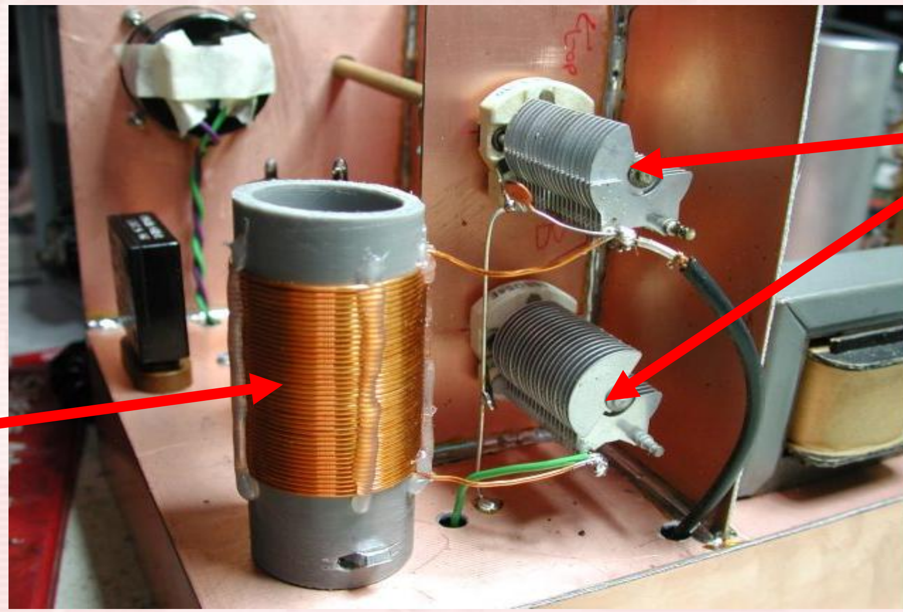
- T6D7 An LED is commonly used as a visual indicator.



An array of LEDs and resistors mounted on a printed circuit board

T6D: Component functions

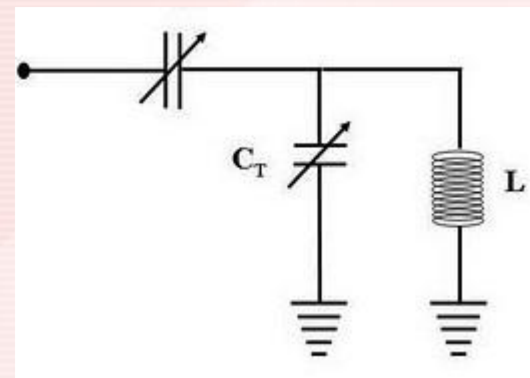
- T6D8 A capacitor is used together with an inductor to make a tuned circuit.



Inductor

Capacitor (variable)

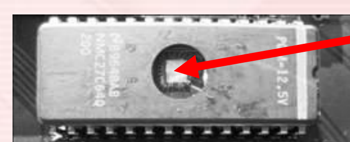
Tank Circuit or Tuned Circuit



Tank Circuit Schematic

- T6D9 Integrated circuit is the name of a device that combines several semiconductors and other components into <u>one package.</u>

Large-scale integrated circuit chip



T6D: Component functions

- T6D10 To control the flow of current is the function of component 2 in Figure T1.

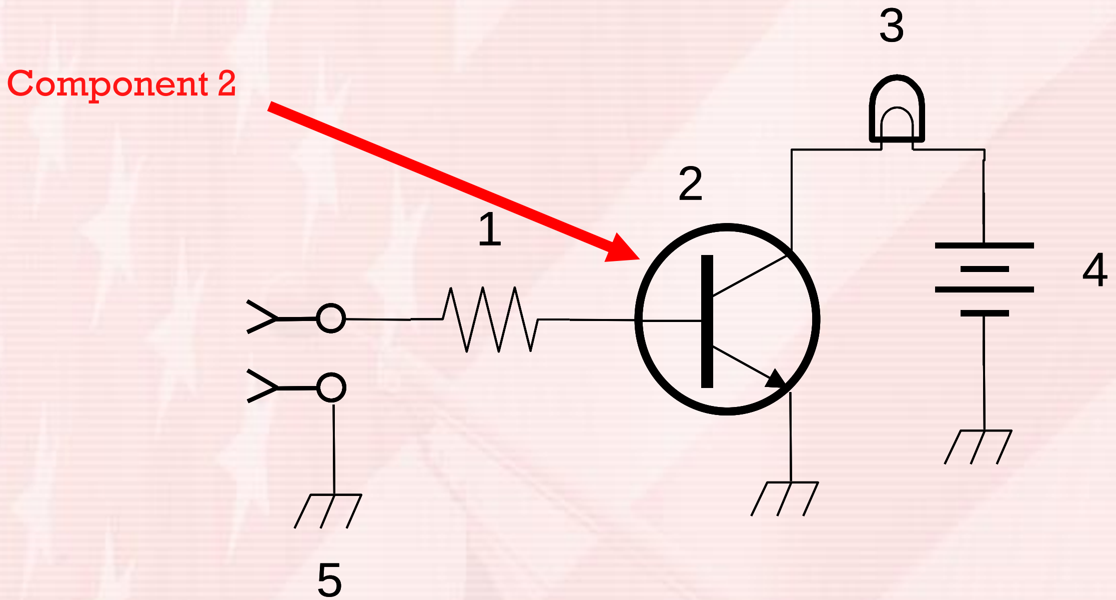


Figure T1

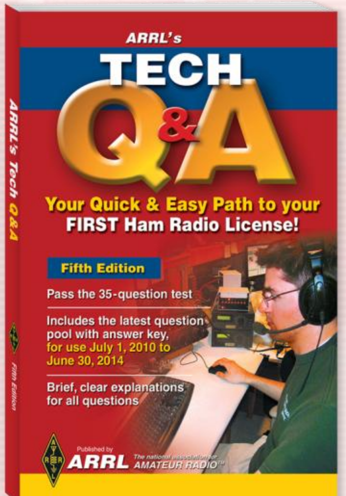
- T6D11 A common use of coaxial cable is to carry RF signals between a radio and antenna.

Element 2 Technician Class Question Pool

T6

Electrical components, semiconductors, circuit diagrams, component functions

[4 Exam Questions – 4 Groups]



Valid July 1, 2010

Through

June 30, 2014

T6A01 What electrical component is used to oppose the flow of current in a DC circuit?

A. Inductor
B. Resistor
C. Voltmeter
D. Transformer

T6A02 What type of component is often used as an adjustable volume control?

A. Fixed resistor
B. Power resistor
C. Potentiometer
D. Transformer

T6A03 What electrical parameter is controlled by a potentiometer?

A. Inductance
B. Resistance
C. Capacitance
D. Field strength

T6A04 What electrical component stores energy in an electric field?

A. Resistor
B. Capacitor
C. Inductor
D. Diode

T6A05 What type of electrical component consists of two or more conductive surfaces separated by an insulator?

A. Resistor
B. Potentiometer
C. Oscillator
D. Capacitor

T6A06 What type of electrical component stores energy in a magnetic field?

A. Resistor
B. Capacitor
C. Inductor
D. Diode

T6A07 What electrical component is usually composed of a coil of wire?

A. Switch
B. Capacitor
C. Diode
D. Inductor

T6A08 What electrical component is used to connect or disconnect electrical circuits?

A. Zener diode
B. Switch
C. Inductor
D. Variable resistor

T6A09 What electrical component is used to protect other circuit components from current overloads?

A. Fuse
B. Capacitor
C. Shield
D. Inductor

T6A10 What is the nominal voltage of a fully charged nickel-cadmium cell?

A. 1.0 volts
B. 1.2 volts
C. 1.5 volts
D. 2.2 volts

T6A11 Which battery type is not rechargeable?

A. Nickel-cadmium
B. Carbon-zinc
C. Lead-acid
D. Lithium-ion

T6B01 What class of electronic components is capable of using a voltage or current signal to control current flow?

A. Capacitors
B. Inductors
C. Resistors
D. Transistors

T6B02 What electronic component allows current to flow in only one direction?

A. Resistor
B. Fuse
C. Diode
D. Driven element

T6B03 Which of these components can be used as an electronic switch or amplifier?

A. Oscillator
B. Potentiometer
C. Transistor
D. Voltmeter

T6B04 Which of these components is made of three layers of semiconductor material?

A. Alternator
B. Bipolar junction transistor
C. Triode
D. Pentagrid converter

T6B05 Which of the following electronic components can amplify signals?

A. Transistor
B. Variable resistor
C. Electrolytic capacitor
D. Multi-cell battery

T6B06 How is a semiconductor diode's cathode lead usually identified?

A. With the word "cathode"
B. With a stripe
C. With the letter "C"
D. All of these choices are correct

T6B07 What does the abbreviation "LED" stand for?

A. Low Emission Diode
B. Light Emitting Diode
C. Liquid Emission Detector
D. Long Echo Delay

T6B08 What does the abbreviation "FET" stand for?

A. Field Effect Transistor
B. Fast Electron Transistor
C. Free Electron Transition
D. Field Emission Thickness

T6B09 What are the names of the two electrodes of a diode?

A. Plus and minus
B. Source and drain
C. Anode and cathode
D. Gate and base

T6B10 Which semiconductor component has an emitter electrode?

A. Bipolar transistor
B. Field effect transistor
C. Silicon diode
D. Bridge rectifier

T6B11 Which semiconductor component has a gate electrode?

A. Bipolar transistor
B. Field effect transistor
C. Silicon diode
D. Bridge rectifier

T6B12 What is the term that describes a transistor's ability to amplify a signal?

A. Gain
B. Forward resistance
C. Forward voltage drop
D. On resistance

T6C01 What is the name for standardized representations of components in an electrical wiring diagram?

A. Electrical depictions
B. Grey sketch
C. Schematic symbols
D. Component callouts

T6C02 What is component 1 in figure T1?

A. Resistor
B. Transistor
C. Battery
D. connector

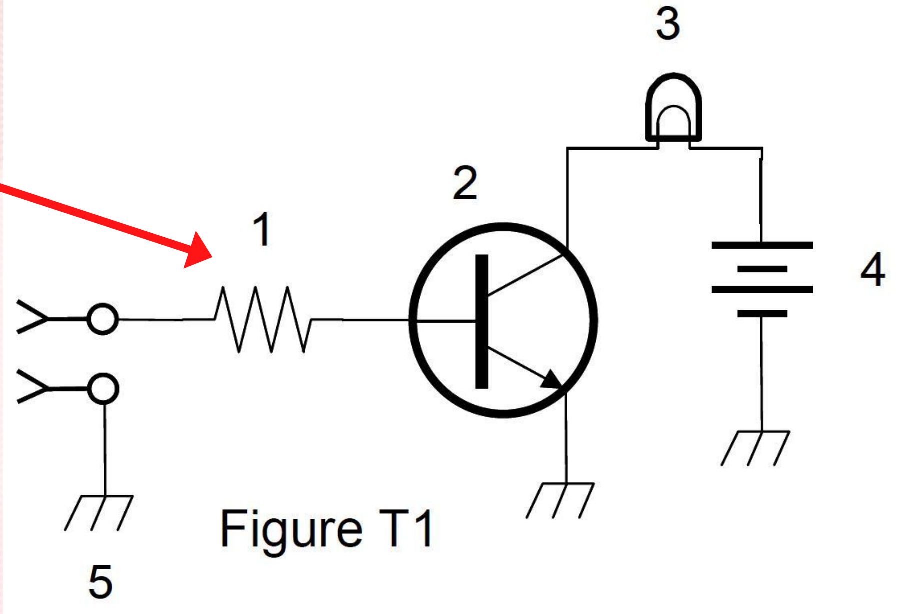
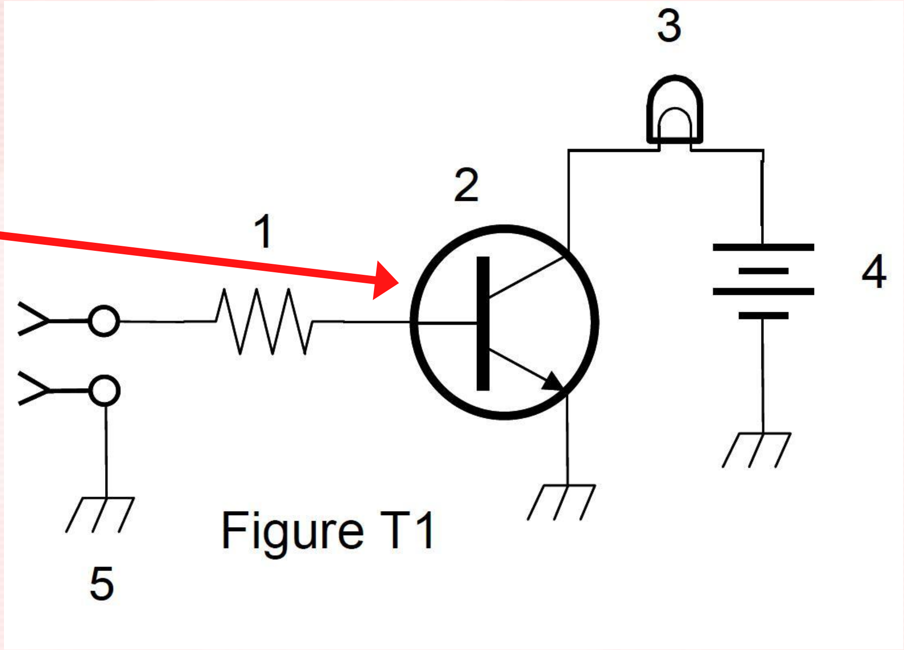


Figure T1

T6C03 What is component 2 in figure T1?

A. Resistor
B. Transistor
C. Indicator lamp
D. Connector



T6C04 What is component 3 in figure T1?

A. Resistor
B. Transistor
C. Lamp
D. Ground symbol

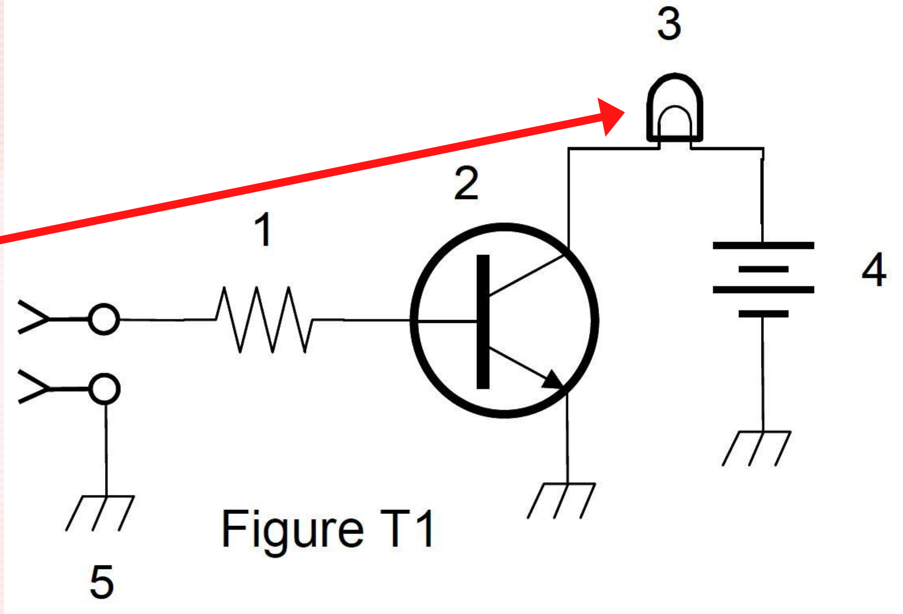


Figure T1

T6C05 What is component 4 in figure T1?

A. Resistor
B. Transistor
C. Battery
D. Ground symbol

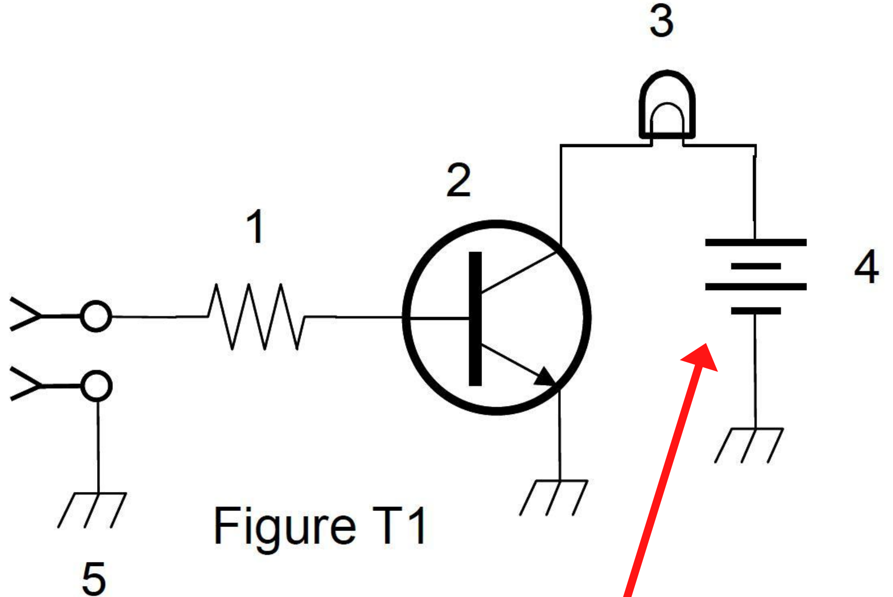


Figure T1

T6C06 What is component 6 in figure T2?

A. Resistor
B. Capacitor
C. Regulator IC
D. Transistor

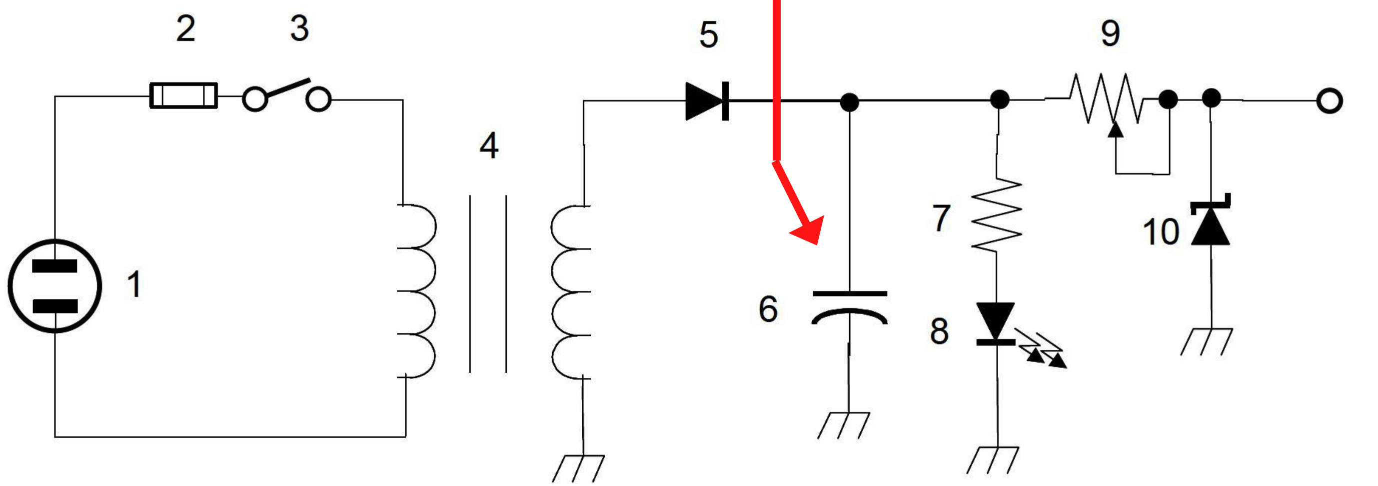


Figure T2

T6C07 What is component 8 in figure T2?

A. Resistor

B. Inductor

C. Regulator IC

D. Light emitting diode

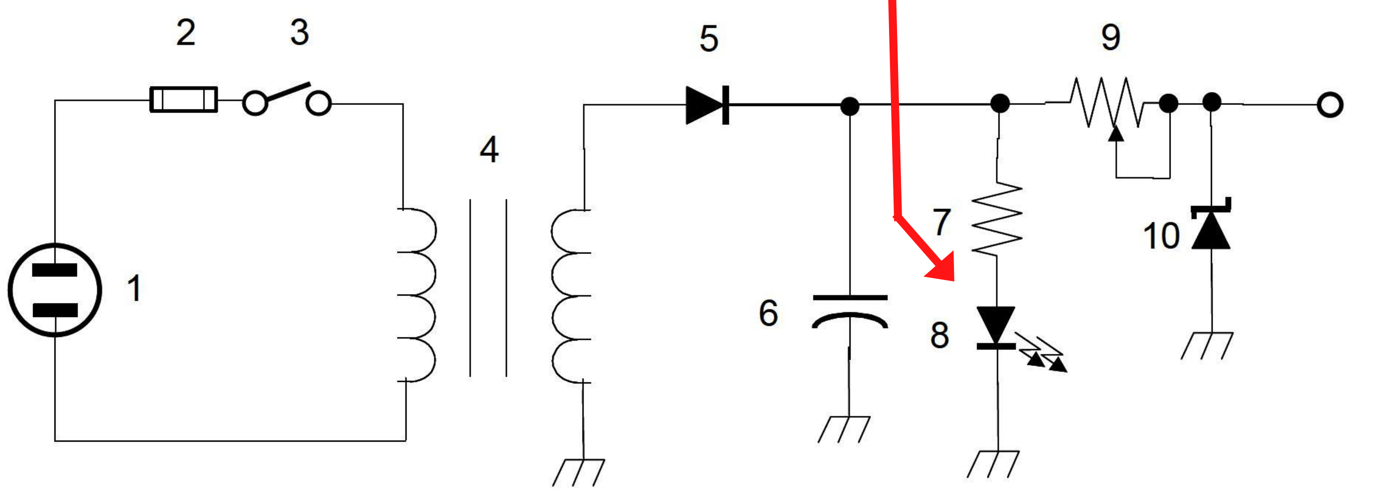


Figure T2

T6C08 What is component 9 in figure T2?

A. Variable capacitor
B. Variable inductor
C. Variable resistor
D. Variable transformer

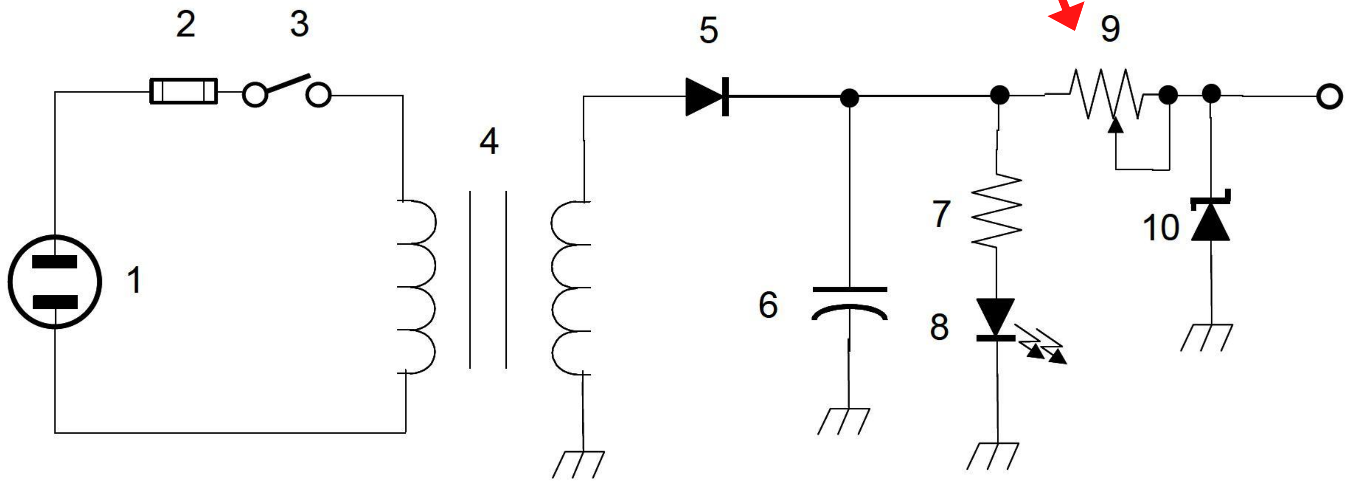


Figure T2

T6C09 What is component 4 in figure T2?

A. Variable inductor

B. Double-pole switch

C. Potentiometer

D. Transformer

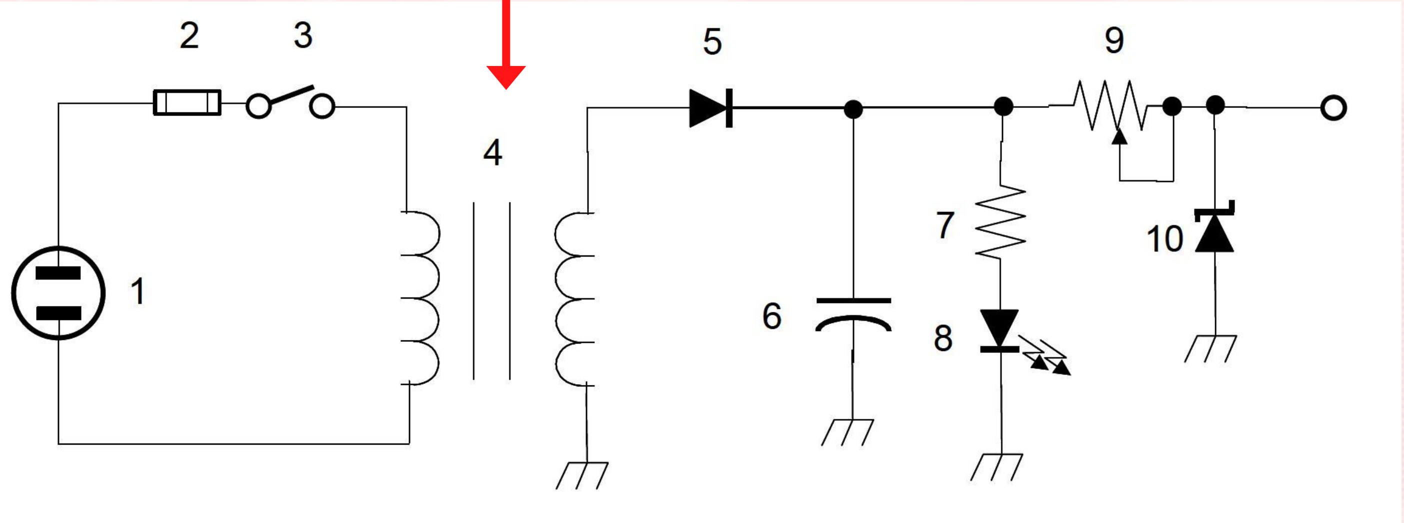


Figure T2

T6C10 What is component 3 in figure T3?

A. Connector
B. Meter
C. Variable capacitor
D. Variable inductor

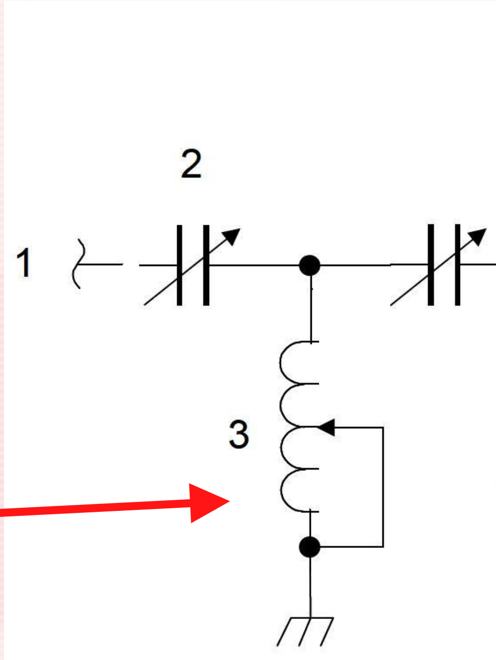


Figure T3

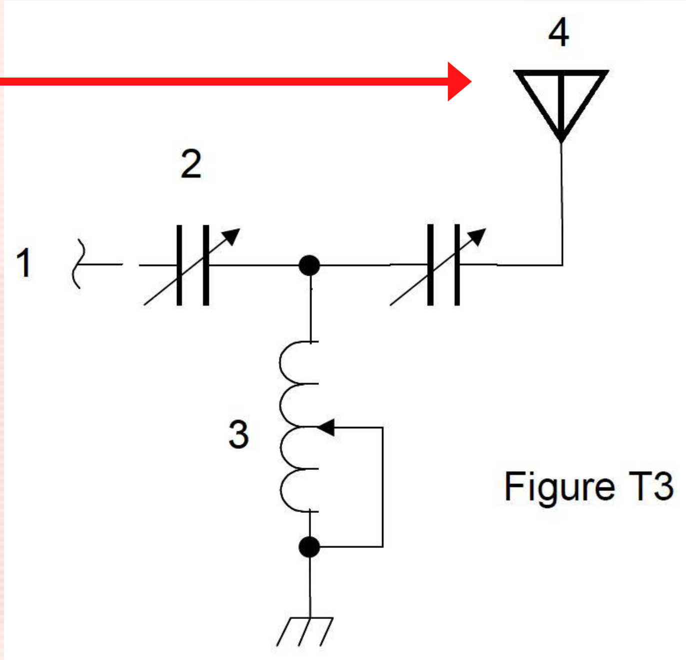
T6C11 What is component 4 in figure T3?

A. Antenna

B. Transmitter

C. Dummy load

D. Ground



T6C12 What do the symbols on an electrical circuit schematic diagram represent?

A. Electrical components
B. Logic states
C. Digital codes
D. Traffic nodes

T6C13 Which of the following is accurately represented in electrical circuit schematic diagrams?

A. Wire lengths
B. Physical appearance of components
C. The way components are interconnected
D. All of these choices

T6D01 Which of the following devices or circuits changes an alternating current into a varying direct current signal?

A. Transformer
B. Rectifier
C. Amplifier
D. Reflector

T6D02 What best describes a relay?

A. A switch controlled by an electromagnet
B. A current controlled amplifier
C. An optical sensor
D. A pass transistor

T6D03 What type of switch is represented by item 3 in figure T2?

A. Single-pole single-throw
B. Single-pole double-throw
C. Double-pole single-throw
D. Double-pole double-throw

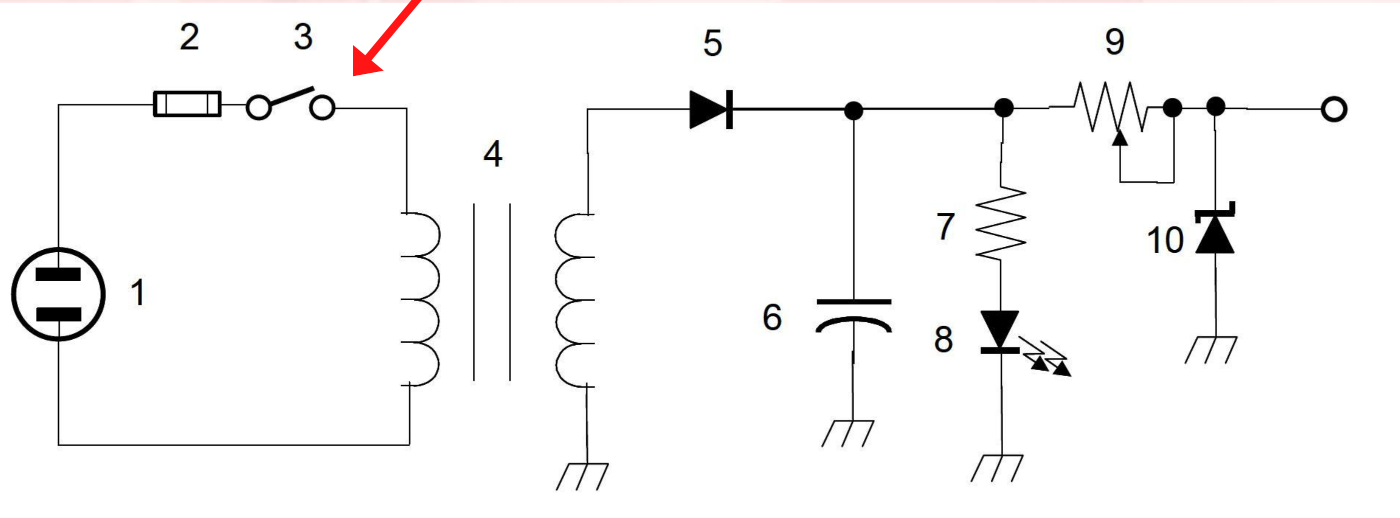


Figure T2

T6D04 Which of the following can be used to display signal strength on a numeric scale?

A. Potentiometer
B. Transistor
C. Meter
D. Relay

T6D05 What type of circuit controls the amount of voltage from a power supply?

A. Regulator
B. Oscillator
C. Filter
D. Phase inverter

T6D06 What component is commonly used to change 120V AC house current to a lower AC voltage for other uses?

A. Variable capacitor
B. Transformer
C. Transistor
D. Diode

T6D07 Which of the following is commonly used as a visual indicator?

A. LED
B. FET
C. Zener diode
D. Bipolar transistor

T6D08 Which of the following is used together with an inductor to make a tuned circuit?

A. Resistor
B. Zener diode
C. Potentiometer
D. Capacitor

T6D09 What is the name of a device that combines several semiconductors and other components into one package?

A. Transducer
B. Multi-pole relay
C. Integrated circuit
D. Transformer

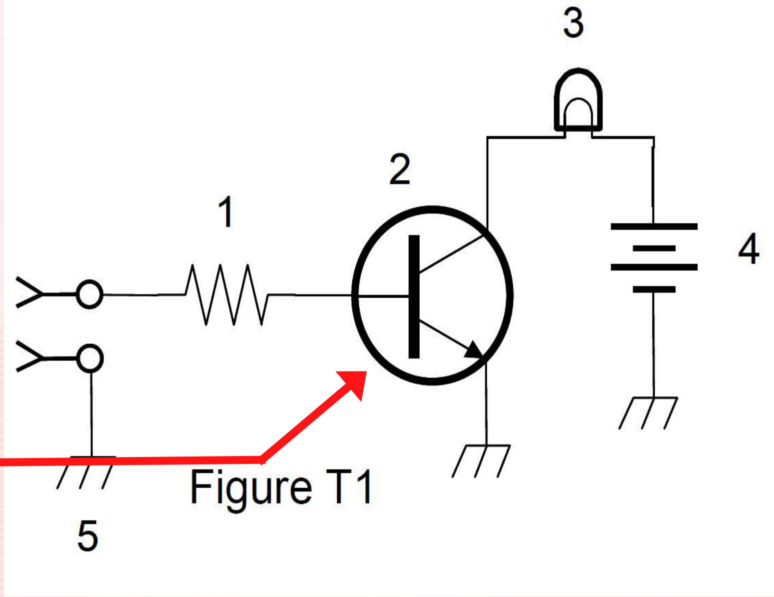
T6D10 What is the function of component 2 in Figure T1?

A. Give off light when current flows through it

B. Supply electrical energy

C. Control the flow of current

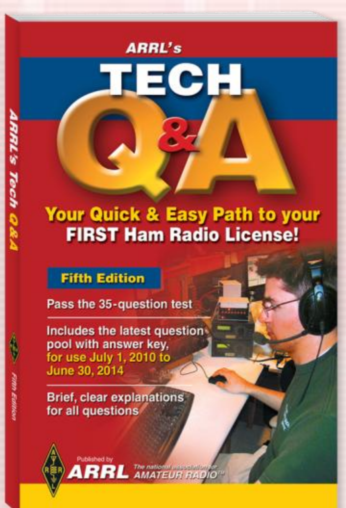
D. Convert electrical energy into radio waves



T6D11 Which of the following is a common use of coaxial cable?

A. Carry dc power from a vehicle battery to a mobile radio
B. Carry RF signals between a radio and antenna
C. Secure masts, tubing, and other cylindrical objects on towers
D. Connect data signals from a TNC to a computer

Technician Licensing Class
“T7”



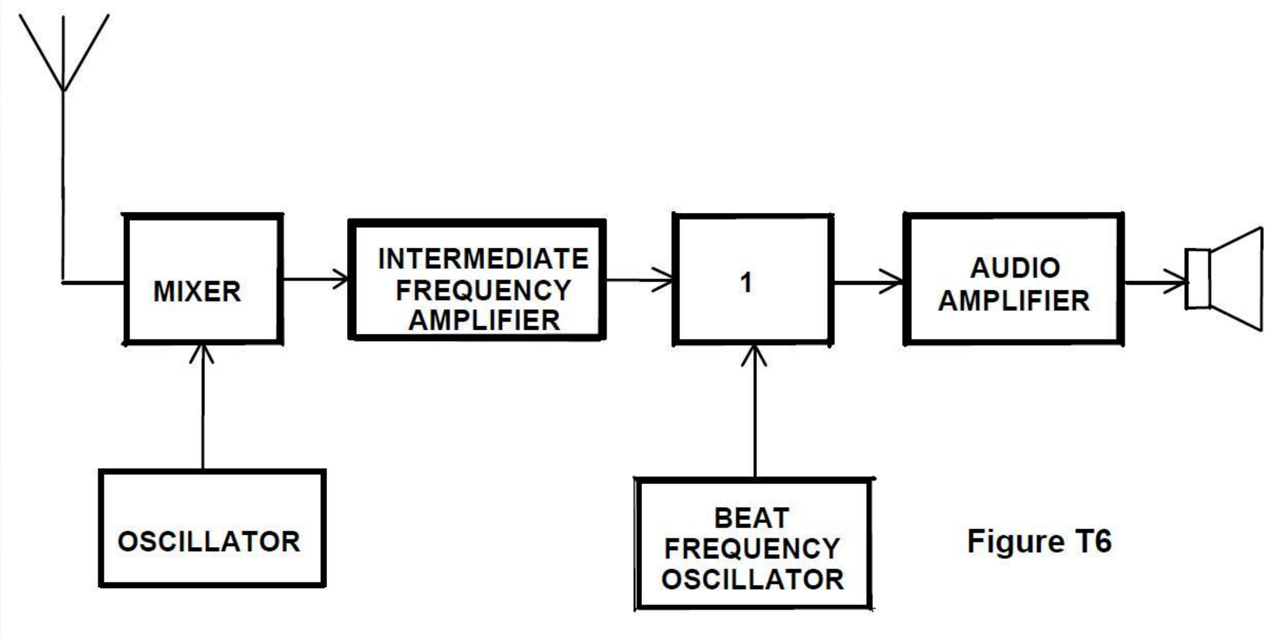
Valid dates:

July 1, 2010 – June 30, 2014

Amateur Radio Technician Class
Element 2 Course Presentation

- **ELEMENT 2 SUB-ELEMENTS**
  - **T1 - FCC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities.**
  - **T2 – Operating Procedures**
  - **T3 – Radio wave characteristics, radio and electromagnetic properties, propagation modes**
  - **T4 – Amateur radio practices and station set up**
  - **T5 – Electrical principles, math for electronics, electronic principles, Ohm's Law**
  - **T6 – Electrical components, semiconductors, circuit diagrams, component functions**
  - **T7 – Station equipment, common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing**
  - **T8 – Modulation modes, amateur satellite operation, operating activities, non-voice communications**
  - **T9 – Antennas, feedlines**
  - **T0 – AC power circuits, antenna installation, RF hazards**

- T7A1 The function of a product detector is to detect CW and SSB signals.
    - Block 1 as a product detector will detect CW and SSB



- A Product detector is necessary in a simple Morse code (CW) and single-sideband (SSB) receiver.

T7A: Station radios; receivers, transmitters, transceivers.

T7A2 The type of receiver shown in Figure T6 is a single-conversion superheterodyne.

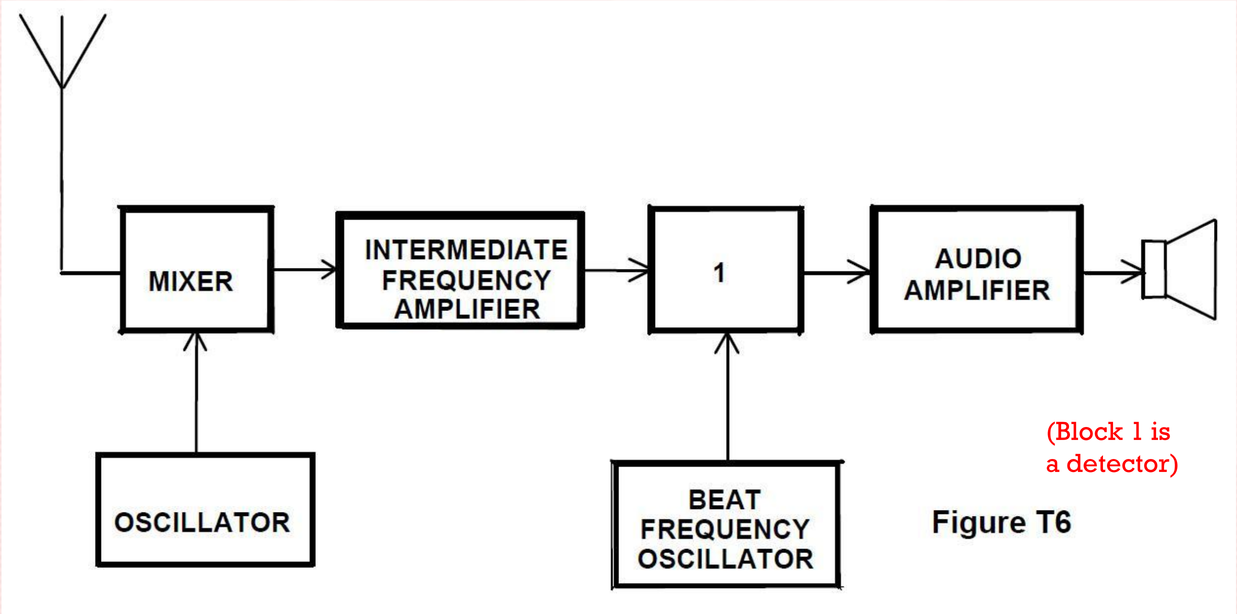
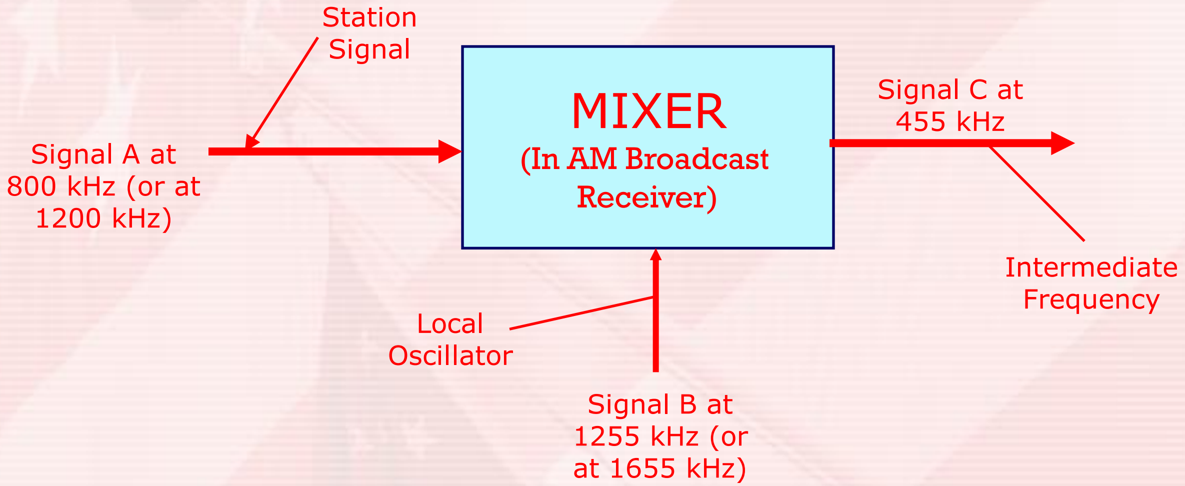


Figure T6

- Single-conversion superhet has only one IF amplifier.

T7A: Station radios; receivers, transmitters, transceivers.

- T7A3 The function of a mixer in a superheterodyne receiver is to shift the incoming signal to an intermediate frequency.
  - Usually referred to as " I F "



Block Diagram of an AM Broadcast Receiver Mixer

- T7A4 The circuit pictured in Figure T7, if block 1 is a frequency discriminator, is an FM receiver.
  - Recovers information contained in the incoming signal
  - Also referred to as a demodulator

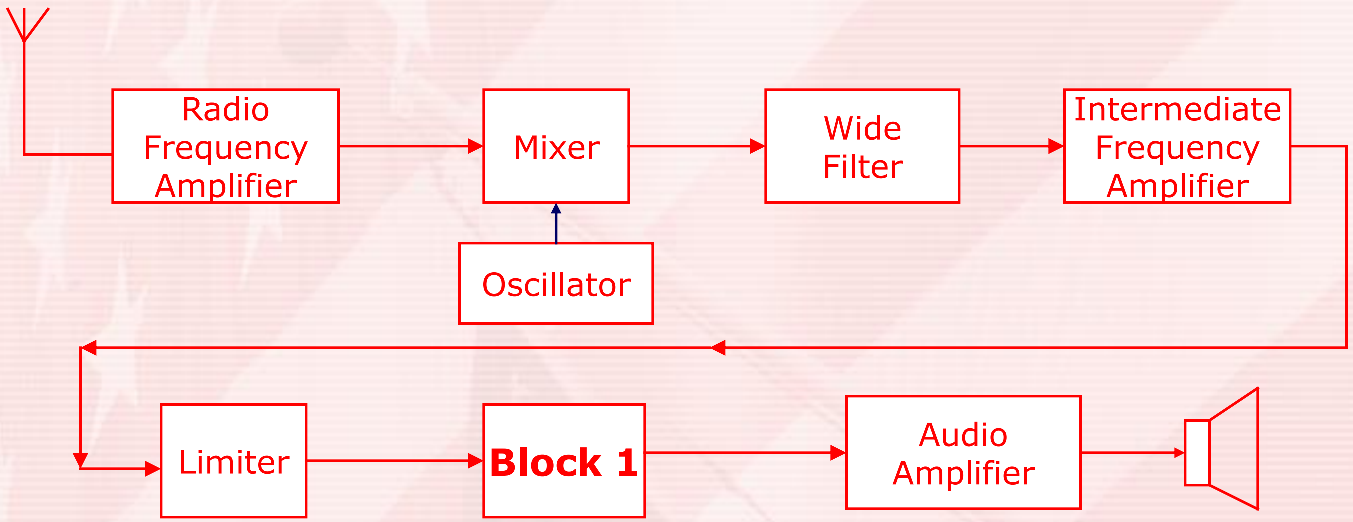


Figure T7

T7A: Station radios; receivers, transmitters, transceivers.

- T7A5 The function of block 1, if figure T4 is a simple CW transmitter is an oscillator.

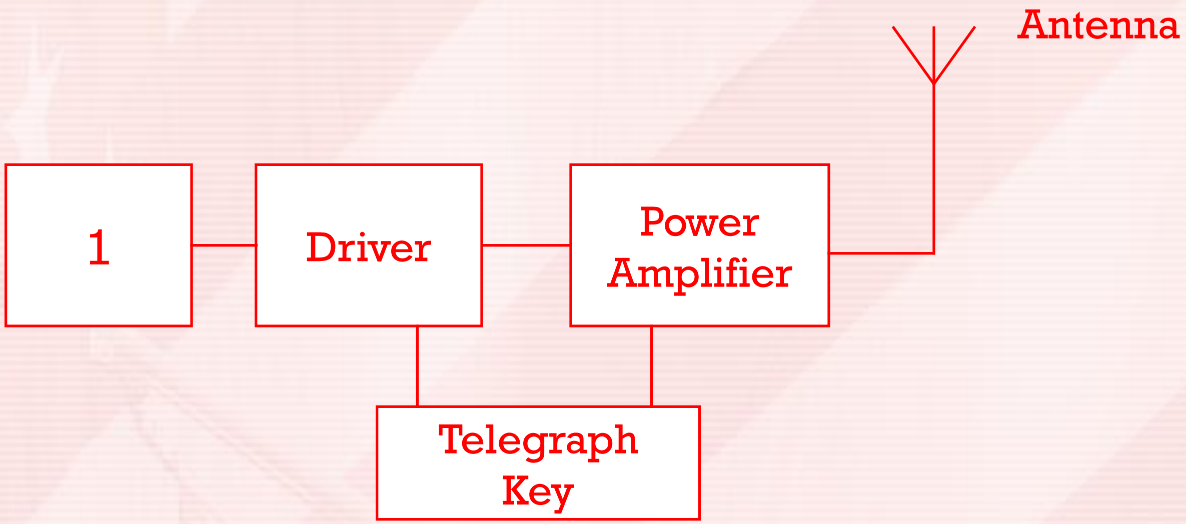


Figure T4

T7A: Station radios; receivers, transmitters, transceivers.

- T7A6 A transverter is a device that takes the output of a low-powered 28 MHz SSB exciter and produces a 222 MHz output signal.

WB6NOA using a 10 GHz transverter that down converts the received signal to 144 MHz into his weak-signal, multi-mode radio.

T7A: Station radios; receivers, transmitters, transceivers.

- T7A7 If figure T5 represents a transceiver in which block 1 is the transmitter portion and block 3 is the receiver portion, the function of block 2 is a transmit-receive switch.

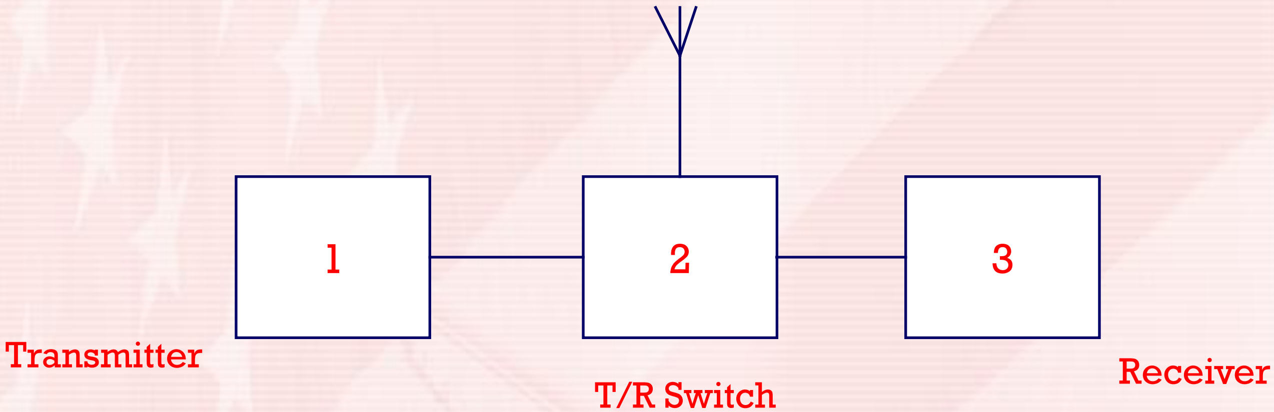
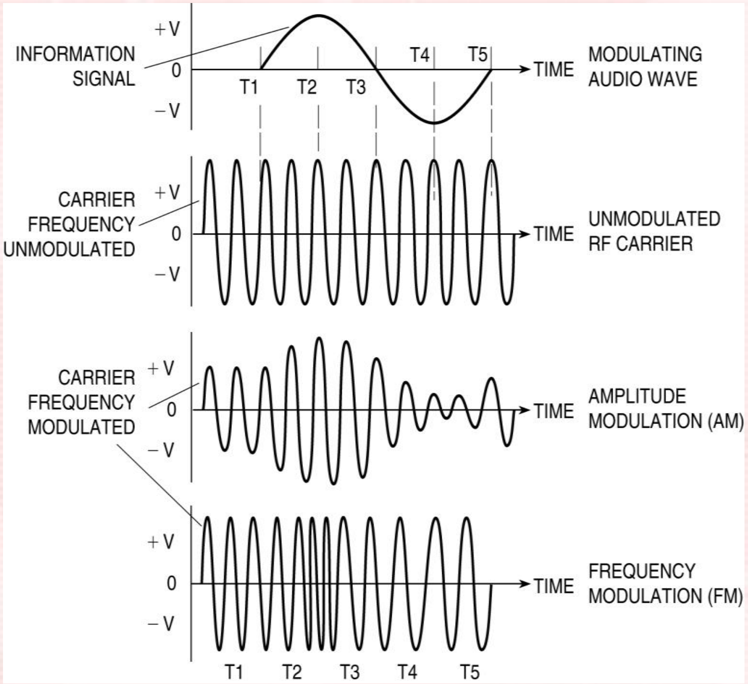


Figure T5

T7A: Station radios; receivers, transmitters, transceivers.

- T7A8 A circuit that combines a speech signal and an RF carrier is a modulator.
- T7A9 A multi-mode VHF transceiver is most useful for VHF weak-signal communication.



Multi-mode VHF/UHF transceiver

T7A: Station radios; receivers, transmitters, transceivers.

- T7A10 An RF power amplifier increases the low-power output from a handheld transceiver.

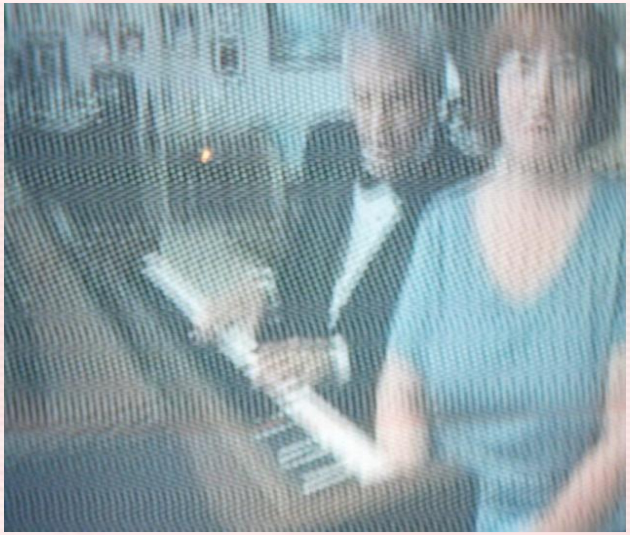
- T7A11 A discriminator demodulates FM signals.
  - Also a detector or demodulator
  - Recovers information

- T7A12 Selectivity is the term that describes the ability of a receiver to discriminate between multiple signals.
- T7A13 An RF preamplifier is installed between the antenna and receiver.

T7B: Common transmitter and receiver problems; symptoms of overload and overdrive, distortion, interference, over and under modulation, RF feedback, off frequency signals; fading and noise; problems with digital communications interfaces

- T7B1 If you are told your FM handheld or mobile transceiver is over deviating, talk farther away from the microphone.
- T7B2 In reference to a receiver, interference by very strong signals causes fundamental overload.

Good TV reception.



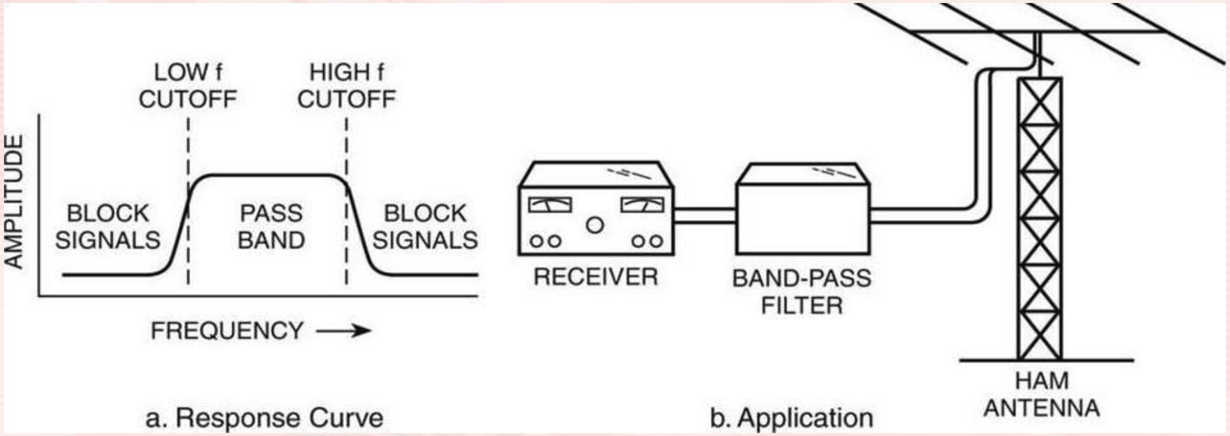
Front end overloaded TV reception

T7B: Common transmitter and receiver problems; symptoms of overload and overdrive, distortion, interference, over and under modulation, RF feedback, off frequency signals; fading and noise; problems with digital communications interfaces

- T7B3 Causes of radio frequency interference:
  - Fundamental overload;
  - Harmonics;
  - Spurious emissions.
- T7B4 The most likely cause of interference to a non-cordless telephone from a nearby transmitter is that the telephone inadvertently acts as a radio receiver.
  - Be aware of inexpensive corded telephones
- T7B5 Install an RF filter at the telephone as a logical first step when attempting to cure a radio frequency interference problem in a nearby telephone.
  - Snap filters over telephone power cord
  - Snap filters over curly cord
  - Snap filters on the actual incoming telephone line cord
    - The more you add, the less likely you'll have interference

T7B: Common transmitter and receiver problems; symptoms of overload and overdrive, distortion, interference, over and under modulation, RF feedback, off frequency signals; fading and noise; problems with digital communications interfaces

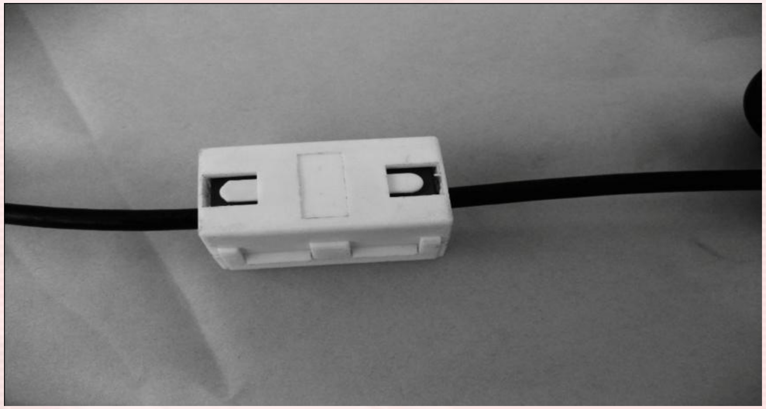
- T7B6 If someone tells you that your station's transmissions are interfering with their radio or TV reception make sure that your station is operating properly and that it does not cause interference to your own television.
  - Double check that your TV is working okay when transmitting
- T7B7 The following may be useful in correcting a radio frequency interference problem:
  - Snap-on ferrite chokes;
  - Low-pass and high-pass filters;
  - Band-reject and band-pass filters.



T7B: Common transmitter and receiver problems; symptoms of overload and overdrive, distortion, interference, over and under modulation, RF feedback, off frequency signals; fading and noise; problems with digital communications interfaces

- T7B8 If a "Part 15" device in your neighbor's home is causing harmful interference to your amateur station:
  - Work with your neighbor to identify the offending device;
  - Politely inform your neighbor about the rules that require him to stop using the device if it causes interference;
  - Check your station and make sure it meets the standards of good amateur practice.

A simple snap-on choke filter like this one can help resolve harmful interference problems on Part 15 devices.

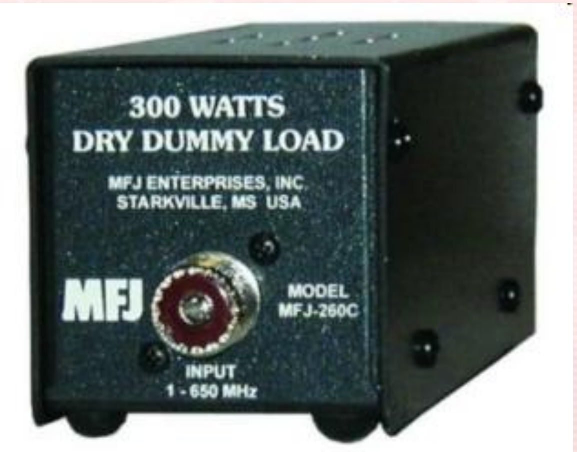


T7B: Common transmitter and receiver problems; symptoms of overload and overdrive, distortion, interference, over and under modulation, RF feedback, off frequency signals; fading and noise; problems with digital communications interfaces

- T7B9 If another operator reports a variable high-pitched whine on the audio from your mobile transmitter, noise on the vehicle's electrical system is being transmitted along with your speech audio.
  - Automobile alternator without filters on leads
- T7B10 If you receive a report that your audio signal through the repeater is distorted or unintelligible:
  - Your transmitter may be slightly off frequency,
  - Your batteries may be running low,
  - You could be in a bad location.
- T7B11 Reports of garbled, distorted, or unintelligible transmissions can be caused by RF feedback in a transmitter or transceiver.
  - Most likely cause is RF feedback between your antenna and mic
- T7B12 When applied to digital communications systems, the acronym "BER" means **B**it **E**rror **R**ate.

T7C: Antenna measurements and troubleshooting; measuring SWR, dummy loads, feedline failure modes.

- T7C1 The primary purpose of a dummy load is to prevent the radiation of signals when making tests.
  - Prevents signals from being sent out over the air
  - Allows observation of signal on Spectrum Analyzer



300 Watt Dry Dummy Load

Dummy Load-Can 1kw with oil

Dry Dummy Load

T7C: Antenna measurements and troubleshooting; measuring SWR, dummy loads, feedline failure modes.

- T7C2 An antenna analyzer can be used to determine if an antenna is resonant at the desired operating frequency.

- T7C3 In general terms, standing wave ratio (SWR) is a measure of how well a load is matched to a transmission line.

MFJ-269 SWR Analyzer

T7C: Antenna measurements and troubleshooting; measuring SWR, dummy loads, feedline failure modes.

- T7C4 A 1 to 1 reading on an SWR meter indicates a perfect impedance match between the antenna and the feedline.

SWR Reading	Antenna Condition
1:1	Perfectly Matched
1.5:1	Good Match
2:1	Fair Match
3:1	Poor Match
4:1	Something definitely Wrong

A battery operated SWR analyzer for tower antenna work

T7C: Antenna measurements and troubleshooting; measuring SWR, dummy loads, feedline failure modes.

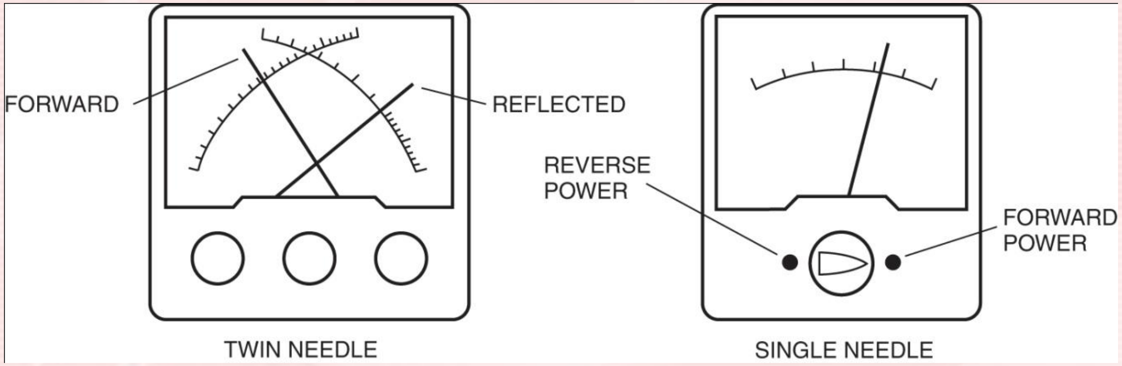
- T7C5 2 to 1 is the approximate SWR value above which the protection circuits in most solid-state transmitters begin to reduce transmitter power.

- T7C6 An SWR reading of 4:1 means there is an impedance mismatch.

- T7C7 Power lost in a feedline is converted into heat.

T7C: Antenna measurements and troubleshooting; measuring SWR, dummy loads, feedline failure modes.

- T7C8 Other than an SWR meter you could use a directional wattmeter to determine if a feedline and antenna are properly matched.



Dual/Twin Needle

Single Needle

T7C: Antenna measurements and troubleshooting; measuring SWR, dummy loads, feedline failure modes.

- T7C9 The most common cause for failure of coaxial cables is moisture contamination.
  - Regular BNC, Type N, and PL259 connectors are not water-tight.

- T7C10 The outer jacket of coaxial cable should be resistant to ultraviolet light because UV light can damage the jacket and allow water to enter the cable.
- T7C11 A disadvantage of "air core" coaxial cable, when compared to foam or solid dielectric types is that it requires special techniques to prevent water absorption.

Smaller Heliax

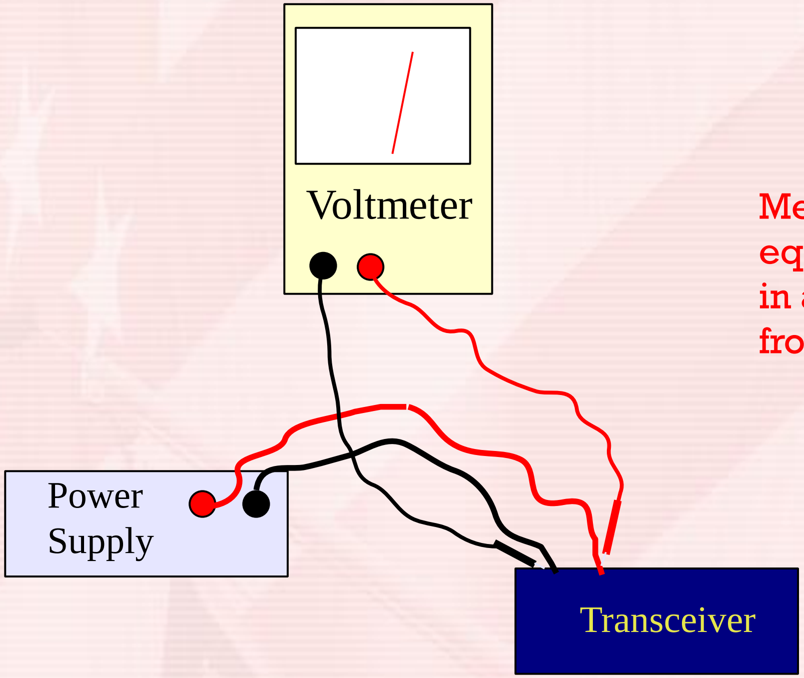
Large coax, with hollow center conductor, low loss

T7D: Basic repair and testing; soldering, use of a voltmeter, ammeter and ohmmeter

- T7D1 A voltmeter is an instrument you would use to measure electric potential or electromotive force.

- T7D2 The correct way to connect a voltmeter to a circuit is in parallel with the circuit.
  - Car battery is measured in parallel
  - House wall sockets are measured in parallel

T7D: Basic repair and testing; soldering, use of a voltmeter, ammeter and ohmmeter

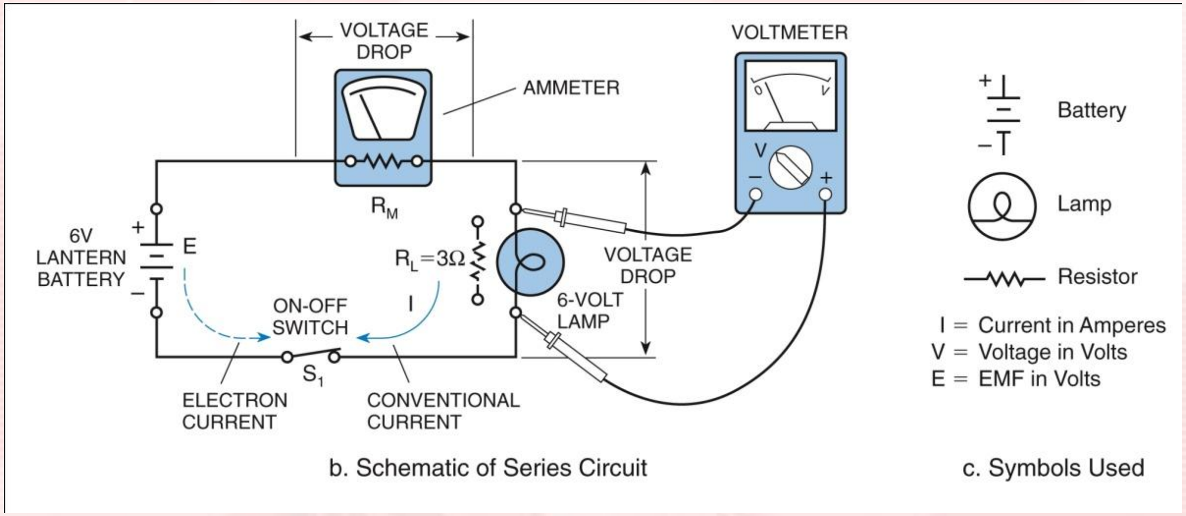


Measure at the equipment to factor in any loss in cables from power source.

T7D: Basic repair and testing; soldering, use of a voltmeter, ammeter and ohmmeter

- T7D3 An ammeter is connected to a circuit in series with the circuit.

- T7D4 An ammeter is an instrument used to measure electric current.

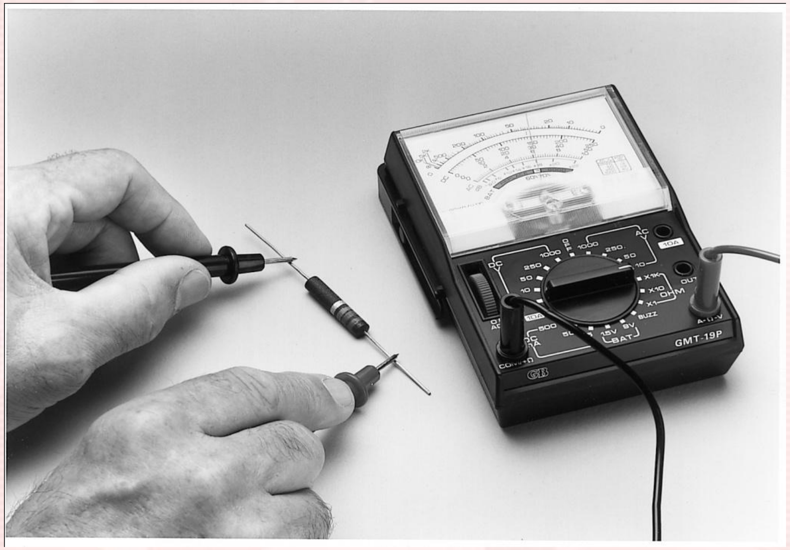


b. Schematic of Series Circuit

c. Symbols Used

T7D: Basic repair and testing; soldering, use of a voltmeter, ammeter and ohmmeter

- T7D5 An ohmmeter is an instrument used to measure resistance.



A D'Arsonval-type meter uses a mechanical needle to indicate the test results.

Digital meter

Both use internal batteries.

Caution: NEVER measure voltage or current in the Ohm position

T7D: Basic repair and testing; soldering, use of a voltmeter, ammeter and ohmmeter

- T7D6 Attempting to measure voltage when using the resistance setting might damage a multimeter.
- T7D7 Voltage and resistance are measurements commonly made using a multimeter.

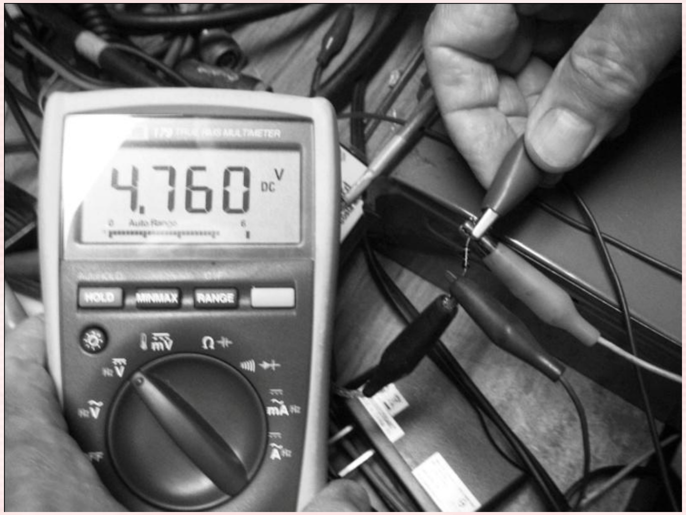
Volt Ohm Meter VOM

Parameter	Basic Unit	Measuring Instrument
Voltage (E)	Volts	Voltmeter
Current (I)	Amperes	Ammeter
Resistance	Ohms10^3	Ohmmeter
Power (P)	Watts	Wattmeter

Digital Volt Ohm Meter
Much more accurate

T7D: Basic repair and testing; soldering, use of a voltmeter, ammeter and ohmmeter

- T7D8 Rosin-core solder is best for radio and electronic use.
- T7D9 A grainy or dull surface is the characteristic appearance of a "cold" solder joint.
- T7D10 When an ohmmeter is connected across a circuit and initially indicates a low resistance and then shows increasing resistance with time, the circuit contains a large capacitor.
- T7D11 A precaution taken when measuring circuit resistance with an ohmmeter is to ensure that the circuit is not powered.

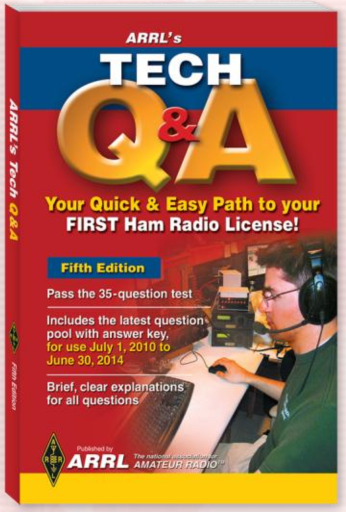


Learning how to use a multimeter is an essential skill in testing and repairing radio gear

Element 2 Technician Class Question Pool

T7

Station equipment; common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing
[4 Exam Questions – 4 Groups]



Valid July 1, 2010

Through

June 30, 2014

T7A01 What is the function of a product detector?

A. Detect phase modulated signals
B. Demodulate FM signals
C. Detect CW and SSB signals
D. Combine speech and RF signals

T7A02 What type of receiver is shown in Figure T6?

A. Direct conversion
B. Super-regenerative
C. Single-conversion superheterodyne
D. Dual-conversion superheterodyne

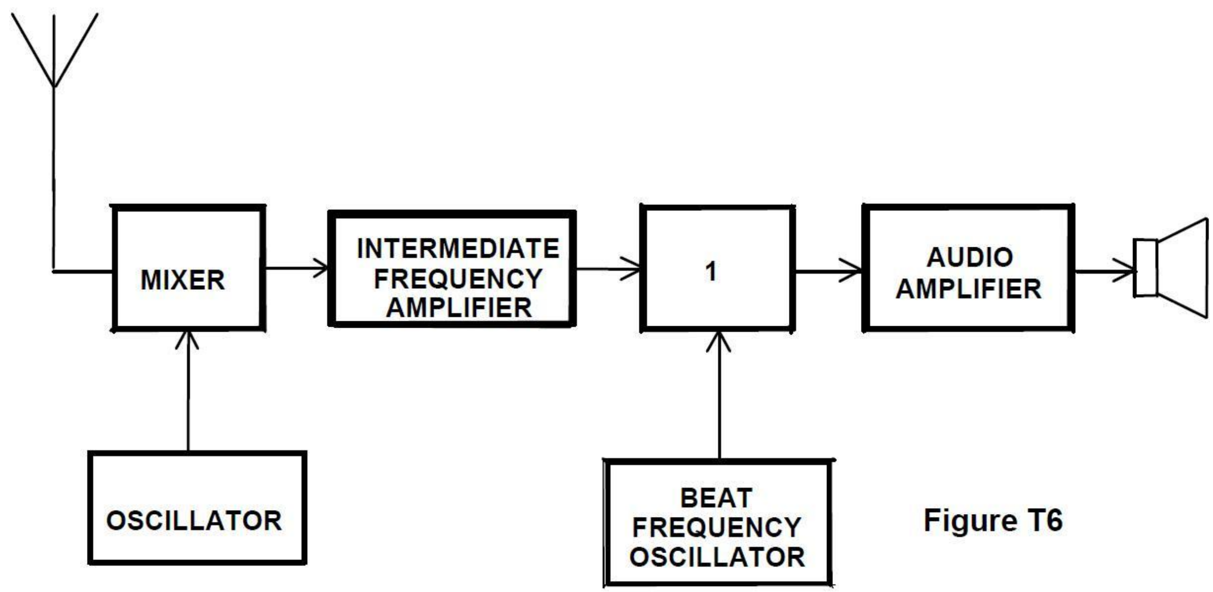


Figure T6

T7A03 What is the function of a mixer in a superheterodyne receiver?

A. To reject signals outside of the desired passband
B. To combine signals from several stations together
C. To shift the incoming signal to an intermediate frequency
D. To connect the receiver with an auxiliary device, such as a TNC

T7A04 What circuit is pictured in Figure T7, if block 1 is a frequency discriminator?

A. A double-conversion receiver

B. A regenerative receiver

C. A superheterodyne receiver

D. An FM receiver

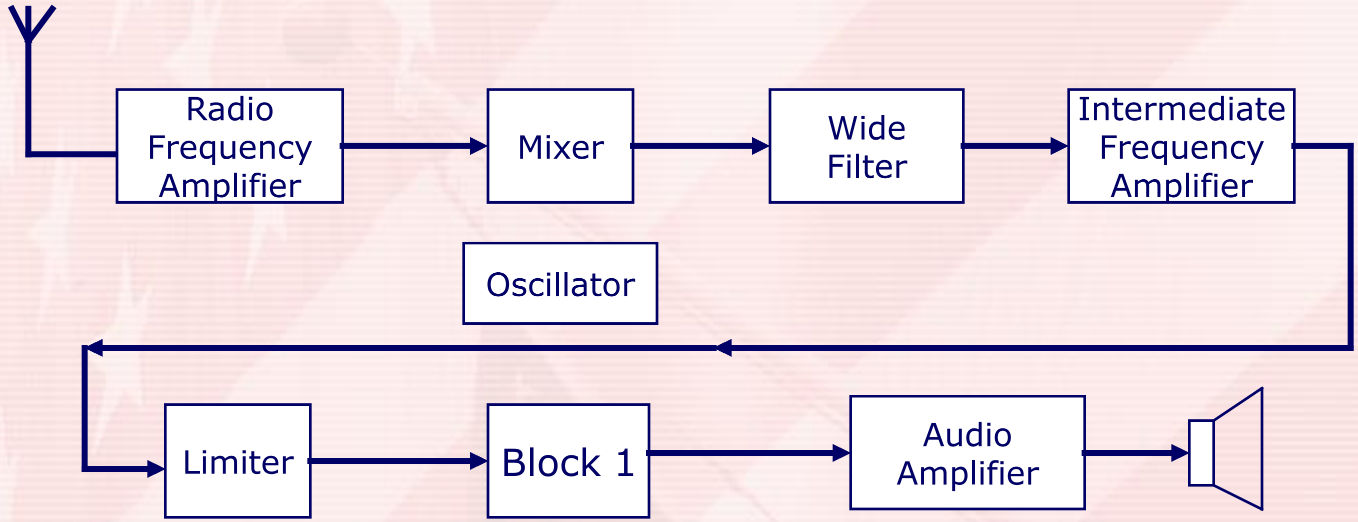


Figure T7

T7A05 What is the function of block 1 if figure T4 is a simple CW transmitter?

A. Reactance modulator
B. Product detector
C. Low-pass filter
D. Oscillator

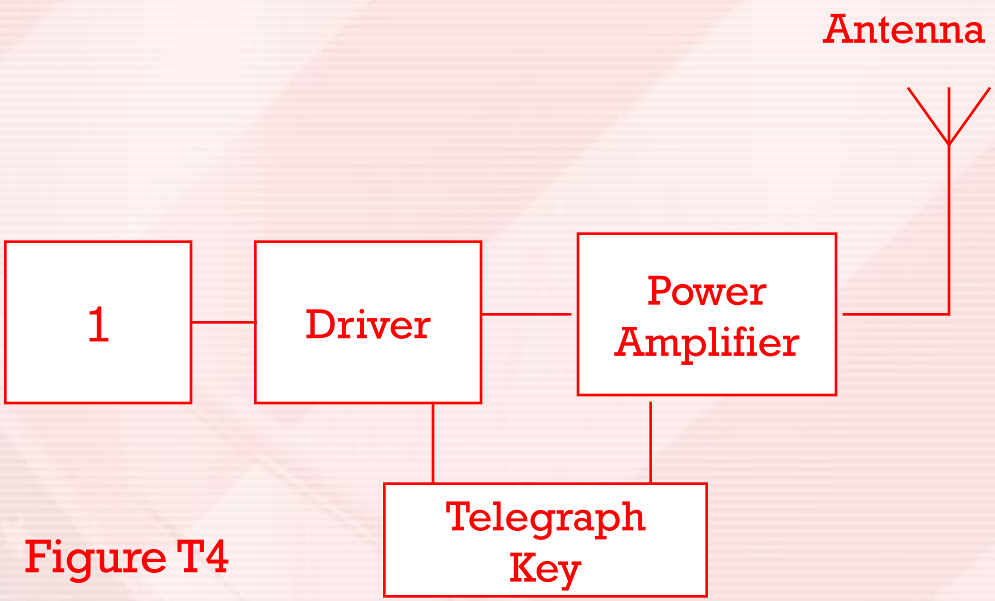


Figure T4

T7A06 What device takes the output of a low-powered 28 MHz SSB exciter and produces a 222 MHz output signal?

A. High-pass filter
B. Low-pass filter
C. Transverter
D. Phase converter

T7A07

If figure T5 represents a transceiver in which block 1 is the transmitter portion and block 3 is the receiver portion, what is the function of block 2?

A. A balanced modulator
B. A transmit-receive switch
C. A power amplifier
D. A high-pass filter

T7A08 Which of the following circuits combines a speech signal and an RF carrier?

A. Beat frequency oscillator
B. Discriminator
C. Modulator
D. Noise blanker

T7A09 Which of the following devices is most useful for VHF weak-signal communication?

A. A quarter-wave vertical antenna
B. A multi-mode VHF transceiver
C. An omni-directional antenna
D. A mobile VHF FM transceiver

T7A10 What device increases the low-power output from a handheld transceiver?

A. A voltage divider
B. An RF power amplifier
C. An impedance network
D. A voltage regulator

T7A11 Which of the following circuits demodulates FM signals?

A. Limiter
B. Discriminator
C. Product detector
D. Phase inverter

T7A12 Which term describes the ability of a receiver to discriminate between multiple signals?

A. Tuning rate
B. Sensitivity
C. Selectivity
D. Noise floor

T7A13 Where is an RF preamplifier installed?

A. Between the antenna and receiver

B. At the output of the transmitter's power amplifier

C. Between a transmitter and antenna tuner

D. At the receiver's audio output

T7B01 What can you do if you are told your FM handheld or mobile transceiver is over deviating?

A. Talk louder into the microphone
B. Let the transceiver cool off
C. Change to a higher power level
D. Talk farther away from the microphone

T7B02 What is meant by fundamental overload in reference to a receiver?

A. Too much voltage from the power supply
B. Too much current from the power supply
C. Interference caused by very strong signals
D. Interference caused by turning the volume up too high

T7B03 Which of the following may be a cause of radio frequency interference?

A. Fundamental overload
B. Harmonics
C. Spurious emissions
D. All of these choices are correct

T7B04 What is the most likely cause of interference to a non-cordless telephone from a nearby transmitter?

A. Harmonics from the transmitter
B. The telephone is inadvertently acting as a radio receiver
C. Poor station grounding
D. Improper transmitter adjustment

T7B05 What is a logical first step when attempting to cure a radio frequency interference problem in a nearby telephone?

A. Install a low-pass filter at the transmitter
B. Install a high-pass filter at the transmitter
C. Install an RF filter at the telephone
D. Improve station grounding

T7B06 What should you do first if someone tells you that your station's transmissions are interfering with their radio or TV reception?

A. Make sure that your station is functioning properly and that it does not cause interference to your own television
B. Immediately turn off your transmitter and contact the nearest FCC office for assistance
C. Tell them that your license gives you the right to transmit and nothing can be done to reduce the interference
D. Continue operating normally because your equipment cannot possibly cause any interference

T7B07 Which of the following may be useful in correcting a radio frequency interference problem?

A. Snap-on ferrite chokes
B. Low-pass and high-pass filters
C. band-reject and band-pass filters
D. All of these choices are correct

T7B08 What should you do if a "Part 15" device in your neighbor's home is causing harmful interference to your amateur station?

A. Work with your neighbor to identify the offending device
B. Politely inform your neighbor about the rules that require him to stop using the device if it causes interference
C. Check your station and make sure it meets the standards of good amateur practice
D. All of these choices are correct

T7B09 What could be happening if another operator reports a variable high-pitched whine on the audio from your mobile transmitter?

A. Your microphone is picking up noise from an open window
B. You have the volume on your receiver set too high
C. You need to adjust your squelch control
D. Noise on the vehicle's electrical system is being transmitted along with your speech audio

T7B10 What might be the problem if you receive a report that your audio signal through the repeater is distorted or unintelligible?

A. Your transmitter may be slightly off frequency
B. Your batteries may be running low
C. You could be in a bad location
D. All of these choices are correct

T7B11 What is a symptom of RF feedback in a transmitter or transceiver?

A. Excessive SWR at the antenna connection
B. The transmitter will not stay on the desired frequency
C. Reports of garbled, distorted, or unintelligible transmissions
D. Frequent blowing of power supply fuses

T7B12 What does the acronym "BER" mean when applied to digital communications systems?

A. Baud Enhancement Recovery
B. Baud Error Removal
C. Bit Error Rate
D. Bit Exponent Resource

T7C01 What is the primary purpose of a dummy load?

A. To prevent the radiation of signals when making tests
B. To prevent over-modulation of your transmitter
C. To improve the radiation from your antenna
D. To improve the signal to noise ratio of your receiver

T7C02 Which of the following instruments can be used to determine if an antenna is resonant at the desired operating frequency?

A. A VTVM
B. An antenna analyzer
C. A “Q” meter
D. A frequency counter

T7C03 What, in general terms, is standing wave ratio (SWR)?

A. A measure of how well a load is matched to a transmission line
B. The ratio of high to low impedance in a feedline
C. The transmitter efficiency ratio
D. An indication of the quality of your station's ground connection

T7C04 What reading on an SWR meter indicates a perfect impedance match between the antenna and the feedline?

A. 2 to 1
B. 1 to 3
C. 1 to 1
D. 10 to 1

T7C05 What is the approximate SWR value above which the protection circuits in most solid-state transmitters begin to reduce transmitter power?

A. 2 to 1
B. 1 to 2
C. 6 to 1
D. 10 to 1

T7C06 What does an SWR reading of 4:1 mean?

A. An antenna loss of 4 dB
B. A good impedance match
C. An antenna gain of 4
D. An impedance mismatch

T7C07 What happens to power lost in a feedline?

A. It increases the SWR
B. It comes back into your transmitter and could cause damage
C. It is converted into heat
D. It can cause distortion of your signal

T7C08 What instrument other than an SWR meter could you use to determine if a feedline and antenna are properly matched?

A. Voltmeter
B. Ohmmeter
C. Iambic pentameter
D. Directional wattmeter

T7C09 Which of the following is the most common cause for failure of coaxial cables?

A. Moisture contamination
B. Gamma rays
C. The velocity factor exceeds 1.0
D. Overloading

T7C10 Why should the outer jacket of coaxial cable be resistant to ultraviolet light?

A. Ultraviolet resistant jackets prevent harmonic radiation
B. Ultraviolet light can increase losses in the cable's jacket
C. Ultraviolet and RF signals can mix together, causing interference
D. Ultraviolet light can damage the jacket and allow water to enter the cable

T7C11 What is a disadvantage of "air core" coaxial cable when compared to foam or solid dielectric types?

A. It has more loss per foot
B. It cannot be used for VHF or UHF antennas
C. It requires special techniques to prevent water absorption
D. It cannot be used at below freezing temperatures

T7D01 Which instrument would you use to measure electric potential or electromotive force?

A. An ammeter
B. A voltmeter
C. A wavemeter
D. An ohmmeter

T7D02 What is the correct way to connect a voltmeter to a circuit?

A. In series with the circuit
B. In parallel with the circuit
C. In quadrature with the circuit
D. In phase with the circuit

T7D03 How is an ammeter usually connected to a circuit?

A. In series with the circuit
B. In parallel with the circuit
C. In quadrature with the circuit
D. In phase with the circuit

T7D04 Which instrument is used to measure electric current?

A. An ohmmeter
B. A wavemeter
C. A voltmeter
D. An ammeter

T7D05 What instrument is used to measure resistance?

A. An oscilloscope
B. A spectrum analyzer
C. A noise bridge
D. An ohmmeter

T7D06 Which of the following might damage a multimeter?

A. Measuring a voltage too small for the chosen scale
B. Leaving the meter in the milliamps position overnight
C. Attempting to measure voltage when using the resistance setting
D. Not allowing it to warm up properly

T7D07 Which of the following measurements are commonly made using a multimeter?

A. SWR and RF power
B. Signal strength and noise
C. Impedance and reactance
D. Voltage and resistance

T7D08 Which of the following types of solder is best for radio and electronic use?

A. Acid-core solder
B. Silver solder
C. Rosin-core solder
D. Aluminum solder

T7D09 What is the characteristic appearance of a "cold" solder joint?

A. Dark black spots
B. A bright or shiny surface
C. A grainy or dull surface
D. A greenish tint

T7D10

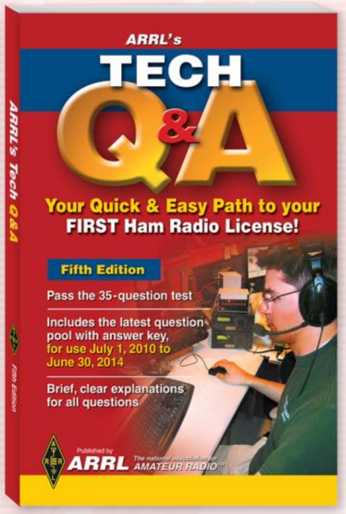
What is probably happening when an ohmmeter, connected across a circuit, initially indicates a low resistance and then shows increasing resistance with time?

A. The ohmmeter is defective
B. The circuit contains a large capacitor
C. The circuit contains a large inductor
D. The circuit is a relaxation oscillator

T7D11 Which of the following precautions should be taken when measuring circuit resistance with an ohmmeter?

A. Ensure that the applied voltages are correct
B. Ensure that the circuit is not powered
C. Ensure that the circuit is grounded
D. Ensure that the circuit is operating at the correct frequency

Technician Licensing Class
“T8”



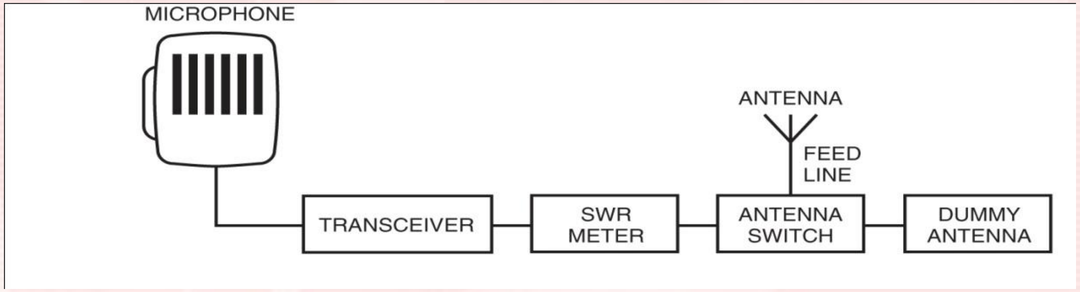
Valid dates:

July 1, 2010 – June 30, 2014

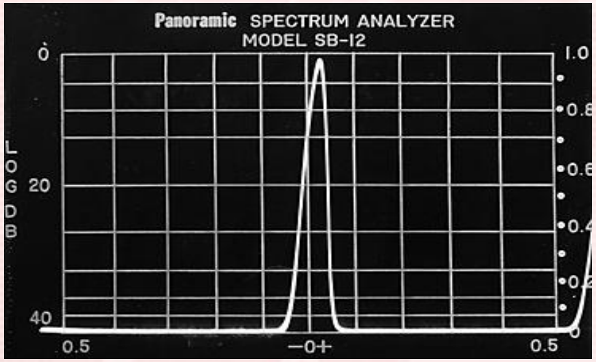
- **ELEMENT 2 SUB-ELEMENTS**
  - **T1 - FCC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities.**
  - **T2 – Operating Procedures**
  - **T3 – Radio wave characteristics, radio and electromagnetic properties, propagation modes**
  - **T4 – Amateur radio practices and station set up**
  - **T5 – Electrical principles, math for electronics, electronic principles, Ohm's Law**
  - **T6 – Electrical components, semiconductors, circuit diagrams, component functions**
  - **T7 – Station equipment, common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing**
  - **T8 – Modulation modes, amateur satellite operation, operating activities, non-voice communications**
  - **T9 – Antennas, feedlines**
  - **T0 – AC power circuits, antenna installation, RF hazards**

T8A: Modulation modes; bandwidth of various signals

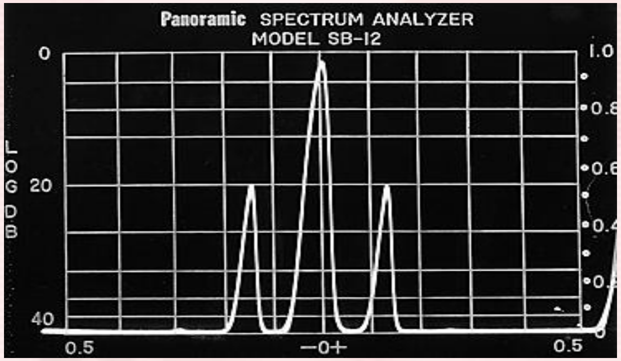
- T8A1 Single sideband is a form of amplitude modulation.



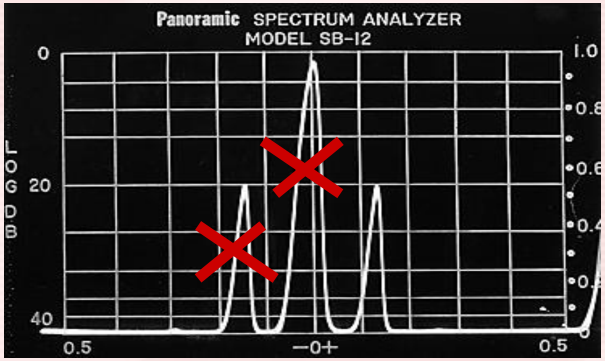
Voice or Phone Station



Carrier only CW



Tones produce both side bands or AM

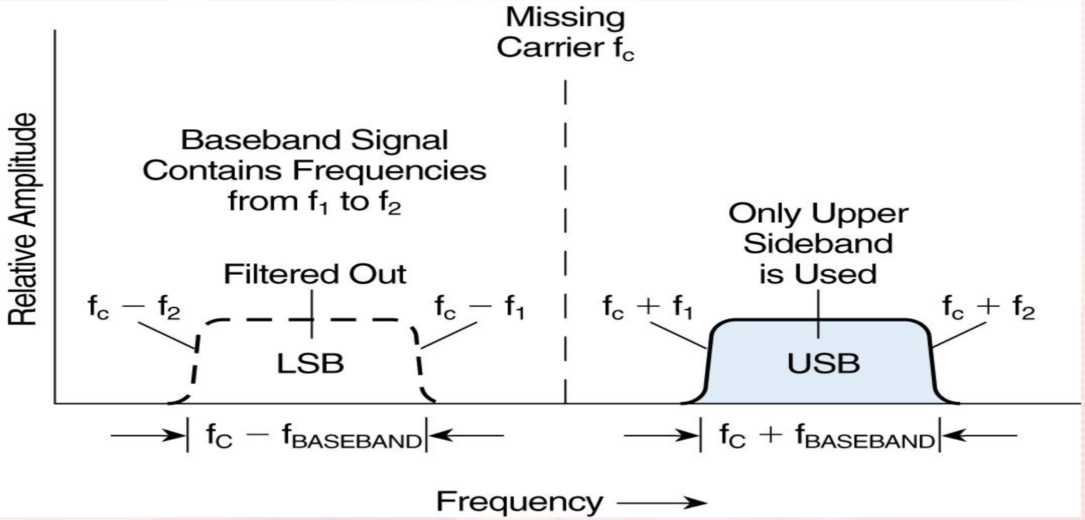


Remove one sideband and suppress carrier becomes SSB

T8A: Modulation modes; bandwidth of various signals

- T8A2 FM is the type of modulation most commonly used for VHF packet radio transmissions.
- T8A3 SSB is the type of voice modulation most often used for long-distance or weak signal contacts on the VHF and UHF bands.
- T8A4 FM is the type of modulation most commonly used for VHF and UHF voice repeaters.
- T8A5 CW is the type of emission that has the narrowest bandwidth.
- T8A6 The sideband normally used for 10 meter HF, VHF and UHF single-sideband communications is upper sideband.
    - Upper sideband is always used on VHF & UHF

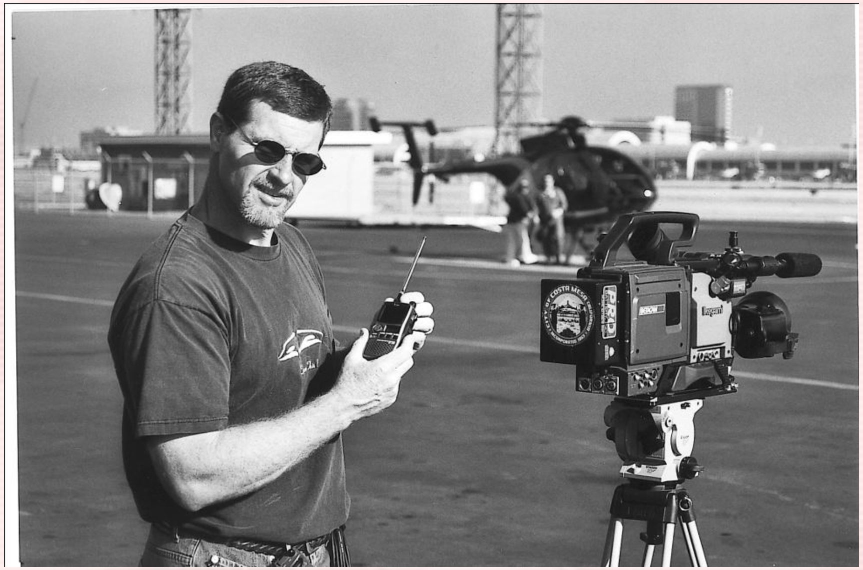
- T8A7 The primary advantage of single sideband over FM for voice transmissions is that SSB signals have narrower bandwidth.
  - SSB uses less bandwidth than FM signals.
- T8A8 3 kHz is the approximate bandwidth of a single sideband voice signal.



SSB signals are Amplitude Modulated (AM) with the carrier and one sideband suppressed.

T8A: Modulation modes; bandwidth of various signals

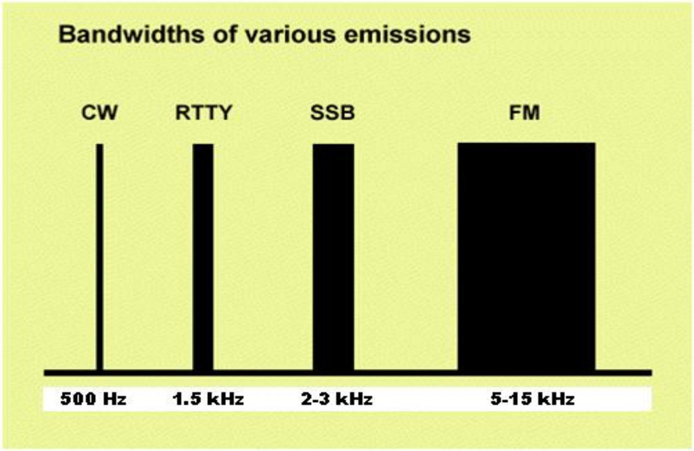
- T8A9 The approximate bandwidth of a VHF repeater FM phone signal is between 5 and 15 kHz.
- T8A10 The typical bandwidth of analog fast-scan TV transmissions on the 70 cm band about 6 MHz.



Amateur TV signals can be received on a variety of equipment – even a small hand-held monitor.

T8A: Modulation modes; bandwidth of various signals

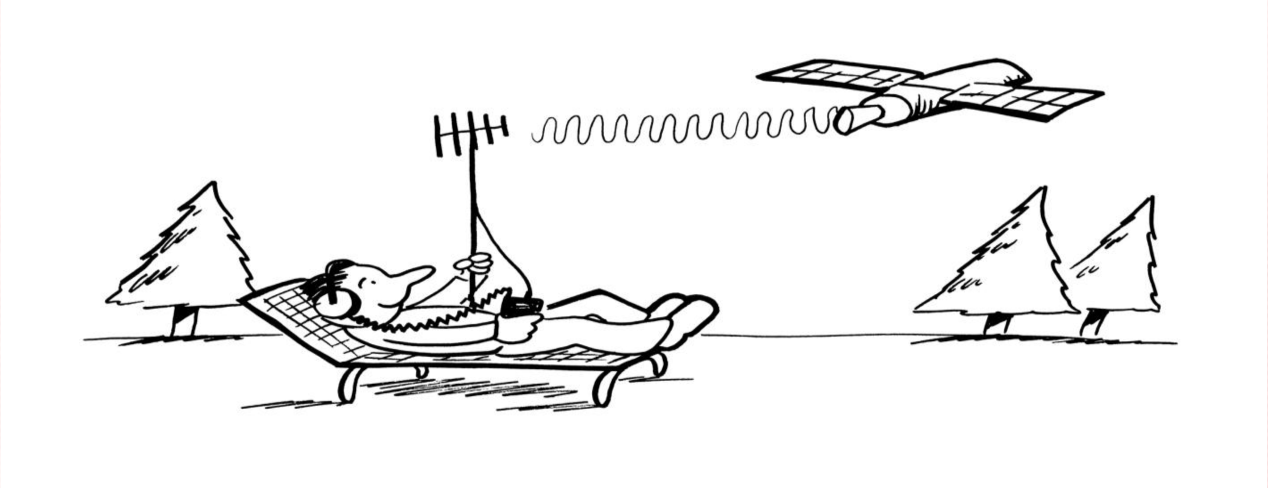
- T8A11 150 Hz is the approximate maximum bandwidth required to transmit a CW signal.



CW Signal	500 Hz wide
SSB Signal	2 - 3 kHz wide
FM Signal	5 - 15 kHz wide
UHF Fast-Scan TV	~ 6 MHz

T8B: Amateur satellite operation; Doppler shift, basic orbits, operating protocols.

- T8B1 Any amateur whose license privileges allow them to transmit on the satellite uplink frequency may be the control operator of a station communicating through an amateur satellite or space station.
- T8B2 The minimum amount of power needed to complete the contact is how much transmitter power should be used on the uplink frequency of an amateur satellite or space station.
  - Just a repeat of previous mention about amount of power output



To work satellites with your handheld, buy a small directional antenna for your satellite radio. You probably won't hear much with your rubber duck antenna.

T8B: Amateur satellite operation; Doppler shift, basic orbits, operating protocols.

- T8B3 Talking to amateur radio operators in other countries can be done using an amateur radio satellite.
- T8B4 Any amateur holding a Technician or higher class license may make contact with an amateur station on the International Space Station using 2-meter and 70 cm band amateur radio frequencies.

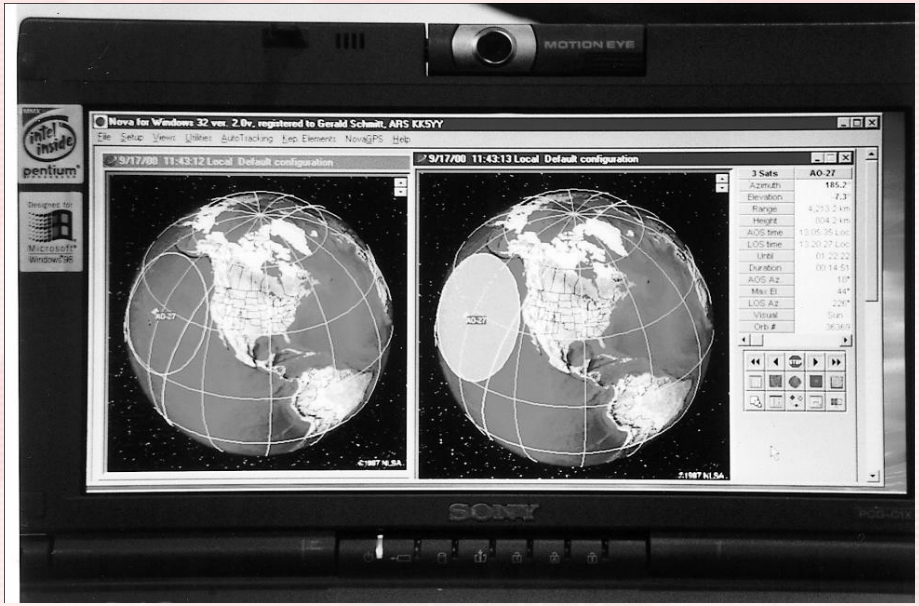
Many Astronaults are licensed radio amateurs.

The International Space Station downlink, FM is 145.800 MHz. Use an HT to listen when it's passing over you.

International Space Station has a big ham station on board.

T8B: Amateur satellite operation; Doppler shift, basic orbits, operating protocols.

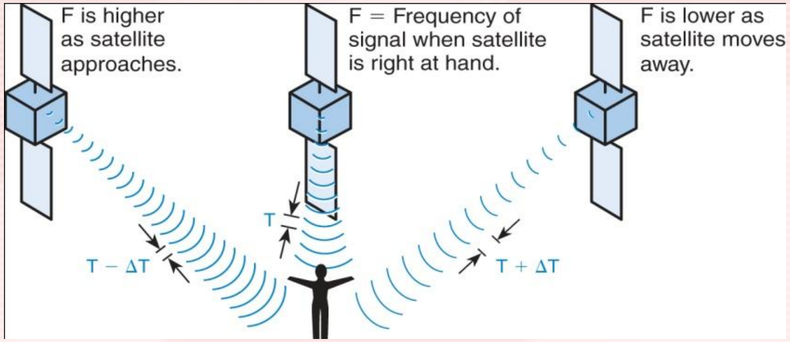
- T8B5 A satellite beacon is a transmission from a space station that contains information about a satellite.
- T8B6 A satellite tracking program can be used to determine the time period during which an amateur satellite or space station can be accessed.



Computer programs and websites can show you where and when an amateur satellite or the Space Station will be in range of your ham station.

T8B: Amateur satellite operation; Doppler shift, basic orbits, operating protocols.

- T8B7 With regards to satellite communications Doppler shift is a change in signal frequency caused by relative motion between the satellite and the earth station.



Doppler Effect

- T8B8 The statement that a satellite is operating in "mode U/V" means that the satellite uplink is in the 70 cm band and the downlink is in the 2 meter band.

Frequency Bands	**Frequency Range**	**Modes**
High Frequency	21 - 30 MHz	Mode H
VHF	144 - 146 MHz	Mode V
UHF	435 - 438 MHz	Mode U
L band	1.26 - 1.27 GHz	Mode L
S band	2.4 - 2.45 GHz	Mode S
C band	5.8 GHz	Mode C
X band	10.4 GHz	Mode X
K band	24 Ghz	Mode K

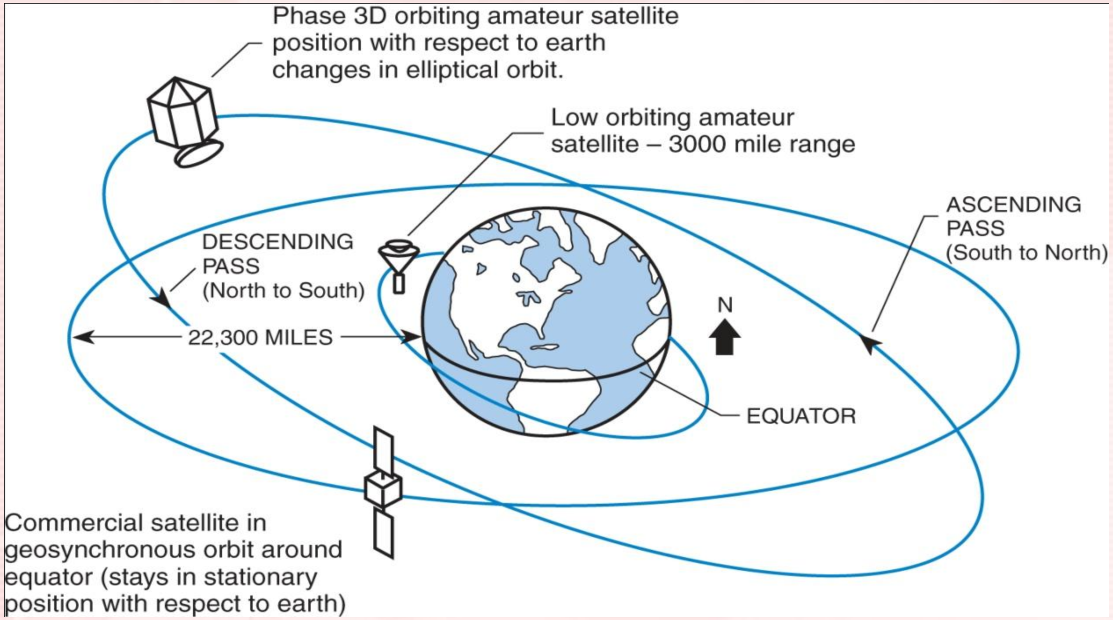
T8B: Amateur satellite operation; Doppler shift, basic orbits, operating protocols.

- T8B9 Rotation of the satellite and its antennas causes "spin fading" when referring to satellite signals.
  - Rotation in space makes the signals fade in and out.
  - This rotation keeps solar panels from overheating.

Tracking and communicating through amateur satellites can be done with a cross-polarized satellite antenna

T8B: Amateur satellite operation; Doppler shift, basic orbits, operating protocols.

- T8B10 The initials LEO tell you an amateur satellite is in a **L**ow **E**arth **O**rbit.

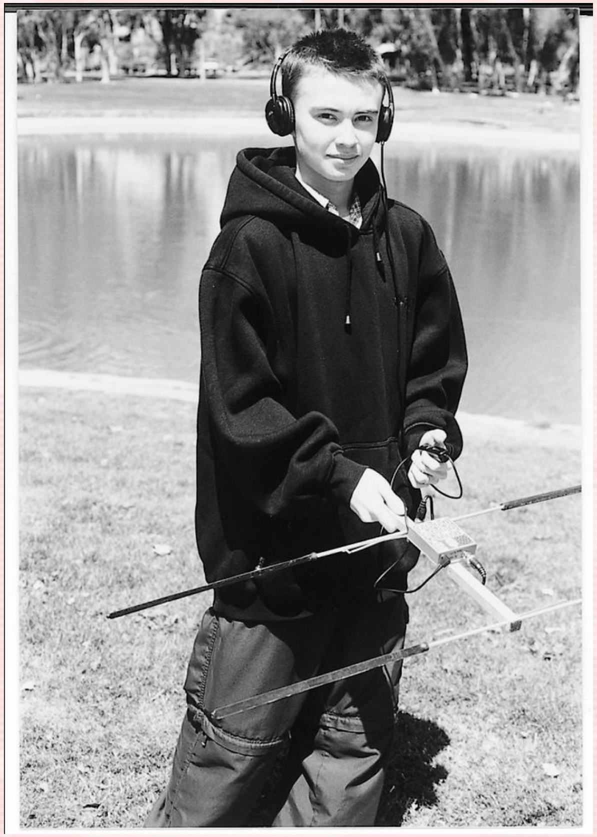


Orbiting Satellites

- T8B11 A commonly used method of sending signals to and from a digital satellite is FM Packet.
  - FM packet a very popular digital communications system
  - Packets usually stored and forwarded, via satellite or space station

T8C: Operating activities; radio directing finding, radio control, contests, special event stations, basic linking over Internet

- T8C1 Radio direction finding methods are used to locate sources of noise interference or jamming.



2-element Yagi DF Antenna

3-element Quad DF Antenna

T8C: Operating activities; radio directing finding, radio control, contests, special event stations, basic linking over Internet

- T8C2 A directional antenna would be useful for a hidden transmitter hunt.

Hidden Transmitter Hunts are called Fox Hunting

All ages participate in a Fox Hunt

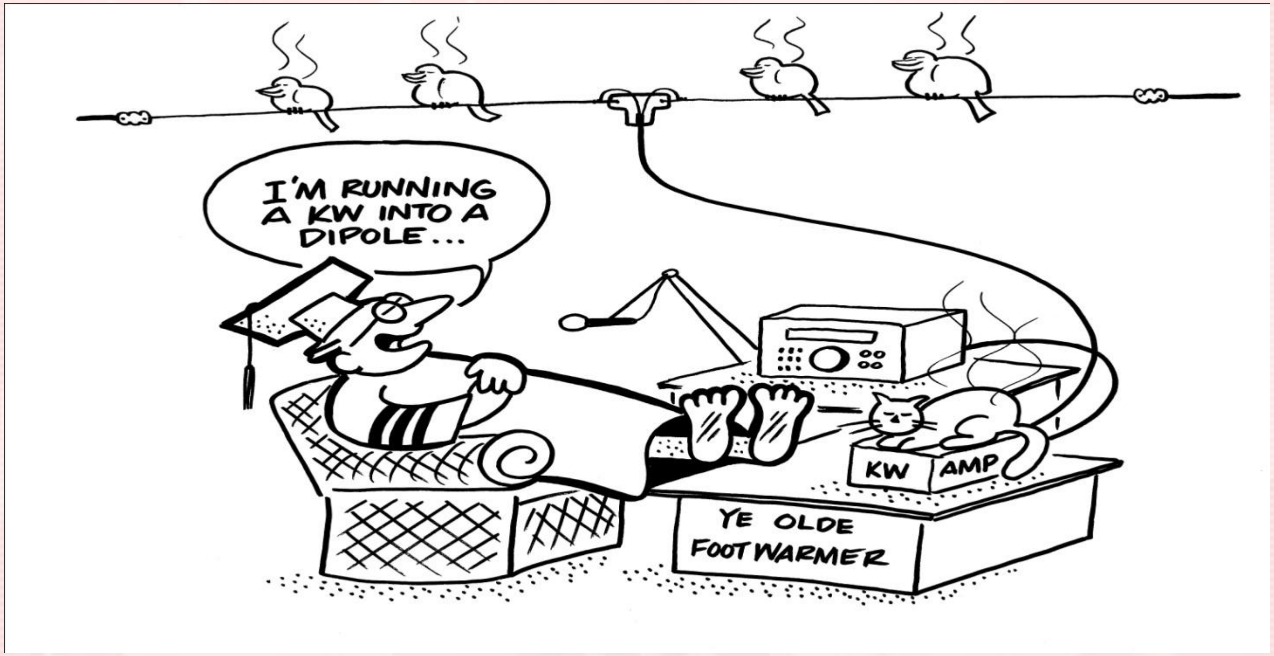
T8C: Operating activities; radio directing finding, radio control, contests, special event stations, basic linking over Internet

- T8C3 Contesting is a popular operating activity that involves contacting as many stations as possible during a specified period of time.



Field Day Every June Enjoyed By Hams the World Over

T8C4 A good procedure when contacting another station in a radio contest is to send only the minimum information needed for proper identification and the contest exchange.

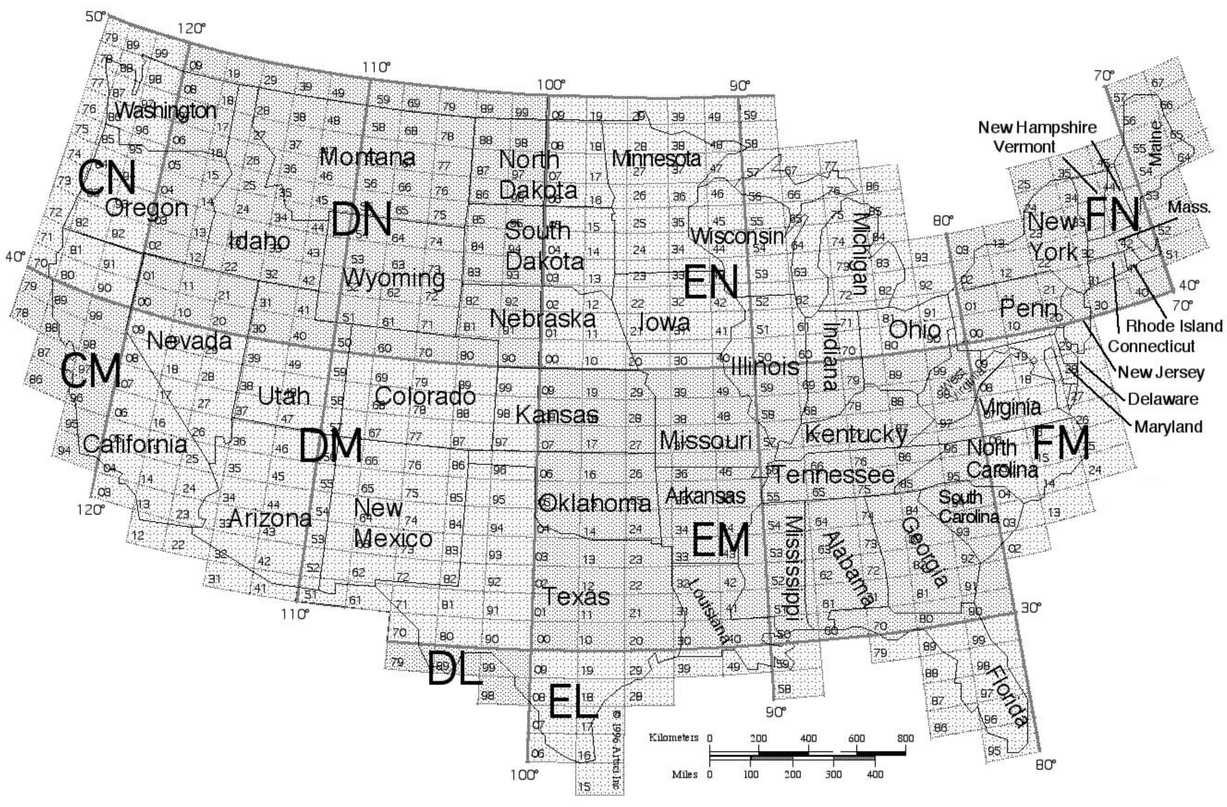


Chit chat is great for normal QSO's, but not for contests.

Contesting needs your call sign and info for contest only.

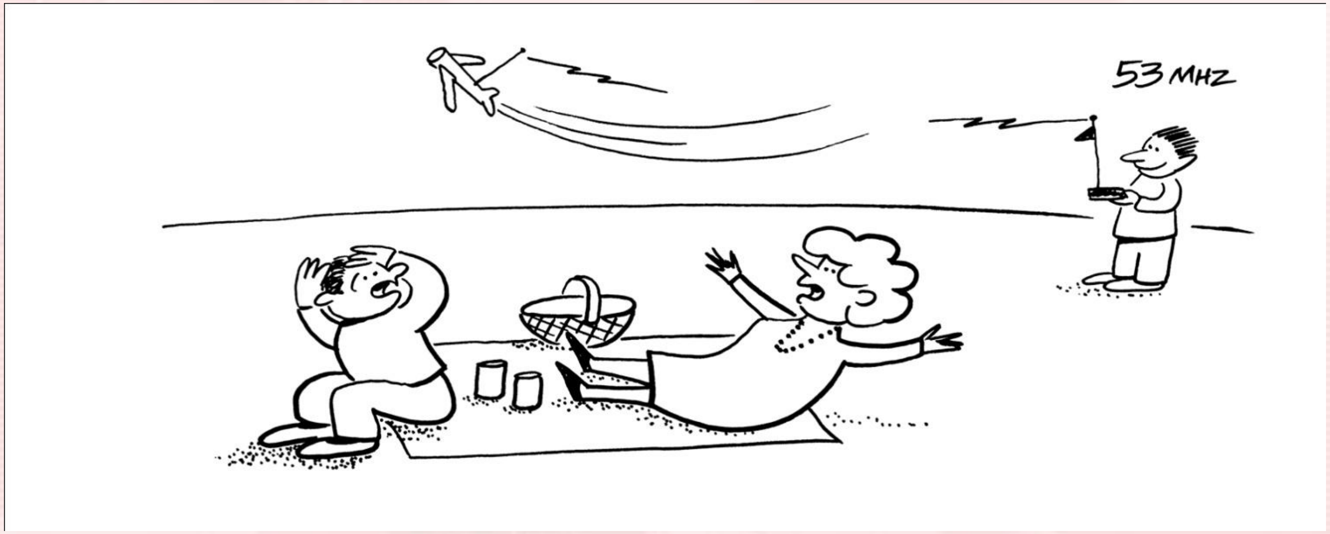
T8C: Operating activities; radio directing finding, radio control, contests, special event stations, basic linking over Internet

- T8C5 A grid locator is a letter-number designator assigned to a geographic location.



T8C: Operating activities; radio directing finding, radio control, contests, special event stations, basic linking over Internet

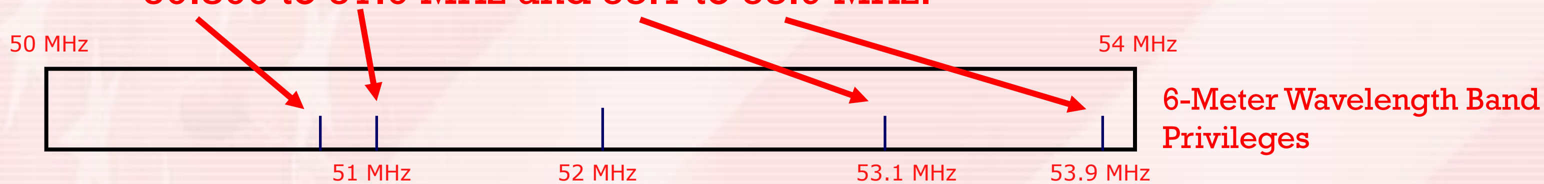
- T8C6 The purpose of a temporary "1 by 1" format (letter-number-letter) assigned call sign is for operations in conjunction with an activity of special significance to the amateur community.
    - W5P N3G W9I
- T8C7 The maximum power allowed when transmitting telecommand signals to radio controlled models is 1 watt.
    - Telecommand signals are unidentified commands permitted by rule.



Hams can use frequencies on the 6-Meter Band to radio control a model aircraft.

T8C: Operating activities; radio directing finding, radio control, contests, special event stations, basic linking over Internet

- T8C8 It is required that a label indicating the licensee's name, call sign and address must be affixed to the transmitter in place of on-air station identification when sending signals to a radio control model using amateur frequencies.
  - Strange radio control signals can be heard using RC:
    - 50.800 to 51.0 MHz and 53.1 to 53.9 MHz.



Licensee's call sign

T8C: Operating activities; radio directing finding, radio control, contests, special event stations, basic linking over Internet

- T8C9 You might obtain a list of active nodes that use VoIP from a repeater directory.
  - The Internet is your best source. (But this is the question for the exam.)
- T8C10 You can select a specific IRLP node when using a portable transceiver by use of the keypad to transmit the IRLP node ID.

Keypad on this rig's top corner and on back of microphone. (Not necessarily this way on all rigs.)

- T8C11 A gateway is the name given to an amateur radio station that is used to connect other amateur stations to the Internet.
  - Similar to a Gateway in connection to a computer network

T8D: Non-voice communications; image data, digital modes CW, packet, PSK31

- T8D1 The following are examples of digital communications methods.
  - Packet
  - PSK31
  - MFSK.
- T8D2 The term APRS means **A**utomatic **P**osition **R**eporting **S**ystem.

Kenwood dual bander plugged into the Avmap G5 GPS position plotter.

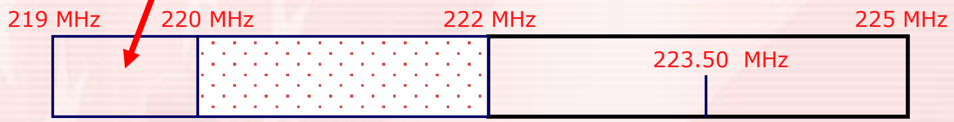
T8D: Non-voice communications; image data, digital modes CW, packet, PSK31

- T8D4 The type of transmission indicated by the term NTSC is an analog fast scan color TV signal.

When you’re ready, you can add the fun of ATV to your ham shack.

T8D: Non-voice communications; image data, digital modes CW, packet, PSK31

- T8D5 Data emission modes may be used by a Technician Class operator between 219 and 220 MHz.
  - 219 to 220 MHz for point-to-point digital message forwarding



1.25-Meter Wavelength Band Privileges

- T8D6 The abbreviation PSK mean **P**hase **S**hift **K**eying.

T8D: Non-voice communications; image data, digital modes CW, packet, PSK31

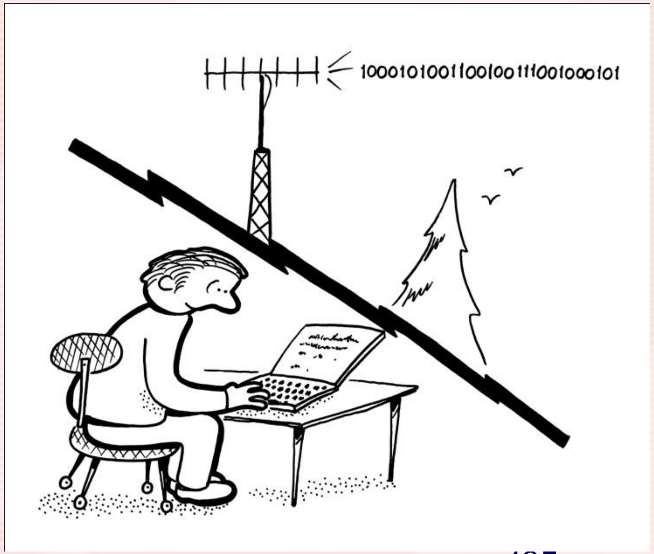
- T8D7 PSK31 is a low-rate data transmission mode.
  - PSK-31 transmission rate is about normal typing speed.
  - PSK is a remarkable digital mode that slices through interference and gets message across sometimes to the moon and back.

You can connect a PSK-31 and RTTY data reader to your radio to decode messages

T8D: Non-voice communications; image data, digital modes CW, packet, PSK31

- T8D8 Packet transmissions may include:
  - A check sum which permits error detection;
  - A header which contains the call sign of the station to which the information is being sent;
  - Automatic repeat request in case of error.

Laptop, TNC, and Handheld comprise Packet Station.



T8D: Non-voice communications; image data, digital modes CW, packet, PSK31

- T8D9 The code used when sending CW in the amateur bands is International Morse.

- T8D10 The following devices can be used to transmit CW in the amateur bands:
  - Straight Key
  - Electronic Keyer
  - Computer Keyboard

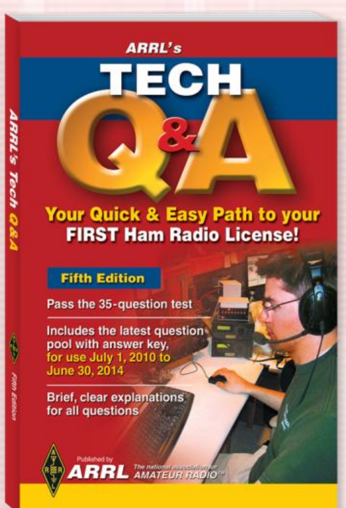
- T8D11 A "parity" bit is an extra code element used to detect errors in received data.
  - Just like a 'parity bit' in computers

Element 2 Technician Class Question Pool

T8

Modulation modes; amateur satellite operation, operating activities, non-voice communications

[4 Exam Questions – 4 Groups]



Valid July 1, 2010

Through

June 30, 2014

T8A01 Which of the following is a form of amplitude modulation?

A. Spread-spectrum
B. Packet radio
C. Single sideband
D. Phase shift keying

T8A02 What type of modulation is most commonly used for VHF packet radio transmissions?

A. FM
B. SSB
C. AM
D. Spread Spectrum

T8A03 Which type of voice modulation is most often used for long-distance or weak signal contacts on the VHF and UHF bands?

A. FM
B. AM
C. SSB
D. PM

T8A04 Which type of modulation is most commonly used for VHF and UHF voice repeaters?

A. AM
B. SSB
C. PSK
D. FM

T8A05 Which of the following types of emission has the narrowest bandwidth?

A. FM voice
B. SSB voice
C. CW
D. Slow-scan TV

T8A06 Which sideband is normally used for 10 meter HF, VHF and UHF single-sideband communications?

A. Upper sideband
B. Lower sideband
C. Suppressed sideband
D. Inverted sideband

T8A07 What is the primary advantage of single sideband over FM for voice transmissions?

A. SSB signals are easier to tune
B. SSB signals are less susceptible to interference
C. SSB signals have narrower bandwidth
D. All of these choices are correct

T8A08 What is the approximate bandwidth of a single sideband voice signal?

A. 1 kHz
B. 3 kHz
C. 6 kHz
D. 15 kHz

T8A09 What is the approximate bandwidth of a VHF repeater FM phone signal?

A. Less than 500 Hz
B. About 150 kHz
C. Between 5 and 15 kHz
D. Between 50 and 125 kHz

T8A10 What is the typical bandwidth of analog fast-scan TV transmissions on the 70 cm band?

A. More than 10 MHz
B. About 6 MHz
C. About 3 MHz
D. About 1 MHz

T8A11 What is the approximate maximum bandwidth required to transmit a CW signal?

A. 2.4 kHz
B. 150 Hz
C. 1000 Hz
D. 15 kHz

T8B01 Who may be the control operator of a station communicating through an amateur satellite or space station?

A. Only an Amateur Extra Class operator
B. A General Class licensee or higher licensee who has a satellite operator certification
C. Only an Amateur Extra Class operator who is also an AMSAT member
D. Any amateur whose license privileges allow them to transmit on the satellite uplink frequency

T8B02 How much transmitter power should be used on the uplink frequency of an amateur satellite or space station?

A. The maximum power of your transmitter

B. The minimum amount of power needed to complete the contact

C. No more than half the rating of your linear amplifier

D. Never more than 1 watt

T8B03 Which of the following can be done using an amateur radio satellite?

A. Talk to amateur radio operators in other countries
B. Get global positioning information
C. Make telephone calls
D. All of these choices are correct

T8B04

Which amateur stations may make contact with an amateur station on the International Space Station using 2 meter and 70 cm ban amateur radio frequencies?

A. Only members of amateur radio clubs at NASA facilities
B. Any amateur holding a Technician or higher class license
C. Only the astronaut's family members who are hams
D. You cannot talk to the ISS on amateur radio frequencies

T8B05 What is a satellite beacon?

A. The primary transmit antenna on the satellite
B. An indicator light that that shows where to point your antenna
C. A reflective surface on the satellite
D. A transmission from a space station that contains information about a satellite

T8B06 What can be used to determine the time period during which an amateur satellite or space station can be accessed?

A. A GPS receiver
B. A field strength meter
C. A telescope
D. A satellite tracking program

T8B07 With regard to satellite communications, what is Doppler shift?

A. A change in the satellite orbit
B. A mode where the satellite receives signals on one band and transmits on another
C. An observed change in signal frequency caused by relative motion between the satellite and the earth station.
D. A special digital communications mode for some satellites

T8B08 What is meant by the statement that a satellite is operating in "mode U/V"?

A. The satellite uplink is in the 15 meter band and the downlink is in the 10 meter band
B. The satellite uplink is in the 70 cm band and the downlink is in the 2 meter band
C. The satellite operates using ultraviolet frequencies
D. The satellite frequencies are usually variable

T8B09 What causes "spin fading" when referring to satellite signals?

A. Circular polarized noise interference radiated from the sun
B. Rotation of the satellite and its antennas
C. Doppler shift of the received signal
D. Interfering signals within the satellite uplink band

T8B10 What do the initials LEO tell you about an amateur satellite?

A. The satellite battery is in Low Energy Operation mode
B. The satellite is performing a Lunar Ejection Orbit maneuver
C. The satellite is in a Low Earth Orbit
D. The satellite uses Light Emitting Optics

T8B11 What is a commonly used method of sending signals to and from a digital satellite?

A. USB AFSK
B. PSK31
C. FM Packet
D. WSJT

T8C01 Which of the following methods is used to locate sources of noise interference or jamming?

A. Echolocation
B. Doppler radar
C. Radio direction finding
D. Phase locking

T8C02 Which of these items would be useful for a hidden transmitter hunt?

A. Calibrated SWR meter
B. A directional antenna
C. A calibrated noise bridge
D. All of these choices are correct

T8C03 What popular operating activity involves contacting as many stations as possible during a specified period of time?

A. Contesting
B. Net operations
C. Public service events
D. Simulated emergency exercises

T8C04 Which of the following is good procedure when contacting another station in a radio contest?

A. Be sure to sign only the last two letters of your call if there is a pileup calling the station
B. Work the station twice to be sure that you are in his log
C. Send only the minimum information needed for proper identification and the contest exchange
D. All of these choices are correct

T8C05 What is a grid locator?

A. A letter-number designator assigned to a geographic location
B. A letter-number designator assigned to an azimuth and elevation
C. An instrument for neutralizing a final amplifier
D. An instrument for radio direction finding

T8C06 For what purpose is a temporary "1 by 1" format (letter-number-letter) call sign assigned?

A. To designate an experimental station

B. To honor a deceased relative who was a radio amateur

C. For operations in conjunction with an activity of special significance to the amateur community

D. All of these choices are correct

T8C07 What is the maximum power allowed when transmitting telecommand signals to radio controlled models?

A. 500 milliwatts
B. 1 watt
C. 25 watts
D. 1500 watts

T8C08 What is required in place of on-air station identification when sending signals to a radio control model using amateur frequencies?

A. Voice identification must be transmitted every 10 minutes
B. Morse code ID must be sent once per hour
C. A label indicating the licensee's name, call sign and address must be affixed to the transmitter
D. A flag must be affixed to the transmitter antenna with the station call sign in 1 inch high letters or larger

T8C09 How might you obtain a list of active nodes that use VoIP?

A. From the FCC Rulebook
B. From your local emergency coordinator
C. From a repeater directory
D. From the local repeater frequency coordinator

T8C10 How do you select a specific IRLP node when using a portable transceiver?

A. Choose a specific CTCSS tone
B. Choose the correct DSC tone
C. Access the repeater autopatch
D. Use the keypad to transmit the IRLP node ID

T8C11 What name is given to an amateur radio station that is used to connect other amateur stations to the Internet?

A. A gateway
B. A repeater
C. A digipeater
D. A beacon

T8D01 Which of the following is an example of a digital communications method?

A. Packet
B. PSK31
C. MFSK
D. All of these choices are correct

T8D02 What does the term APRS mean?

A. Automatic Position Reporting System
B. Associated Public Radio Station
C. Auto Planning Radio Set-up
D. Advanced Polar Radio System

T8D03 Which of the following is normally used when sending automatic location reports via amateur radio?

A. A connection to the vehicle speedometer
B. A WWV receiver
C. A connection to a broadcast FM sub-carrier receiver
D. A Global Positioning System receiver

T8D04 What type of transmission is indicated by the term NTSC?

A. A Normal Transmission mode in Static Circuit
B. A special mode for earth satellite uplink
C. An analog fast scan color TV signal
D. A frame compression scheme for TV signals

T8D05 Which of the following emission modes may be used by a Technician Class operator between 219 and 220 MHz?

A. Spread spectrum
B. Data
C. SSB voice
D. Fast-scan television

T8D06 What does the abbreviation PSK mean?

A. Pulse Shift Keying
B. Phase Shift Keying
C. Packet Short Keying
D. Phased Slide Keying

T8D07 What is PSK31?

A. A high-rate data transmission mode
B. A method of reducing noise interference to FM signals
C. A method of compressing digital television signal
D. A low-rate data transmission mode

T8D08 Which of the following may be included in packet transmissions?

A. A check sum which permits error detection

B. A header which contains the call sign of the station to which the information is being sent

C. Automatic repeat request in case of error

D. All of these choices are correct

T8D09 What code is used when sending CW in the amateur bands?

A. Baudot
B. Hamming
C. International Morse
D. Gray

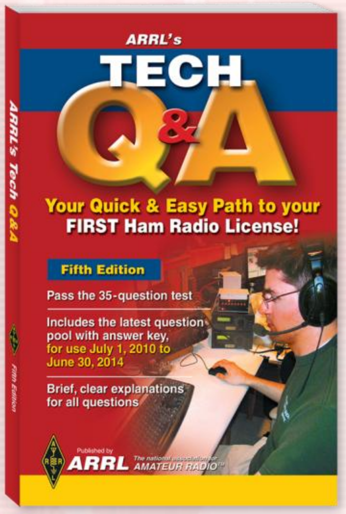
T8D10 Which of the following can be used to transmit CW in the amateur bands?

A. Straight Key
B. Electronic Keyer
C. Computer Keyboard
D. All of these choices are correct

T8D11 What is a "parity" bit?

A. A control code required for automatic position reporting
B. A timing bit used to ensure equal sharing of a frequency
C. An extra code element used to detect errors in received data
D. A "triple width" bit used to signal the end of a character

Technician Licensing Class
“T9”



Valid dates:

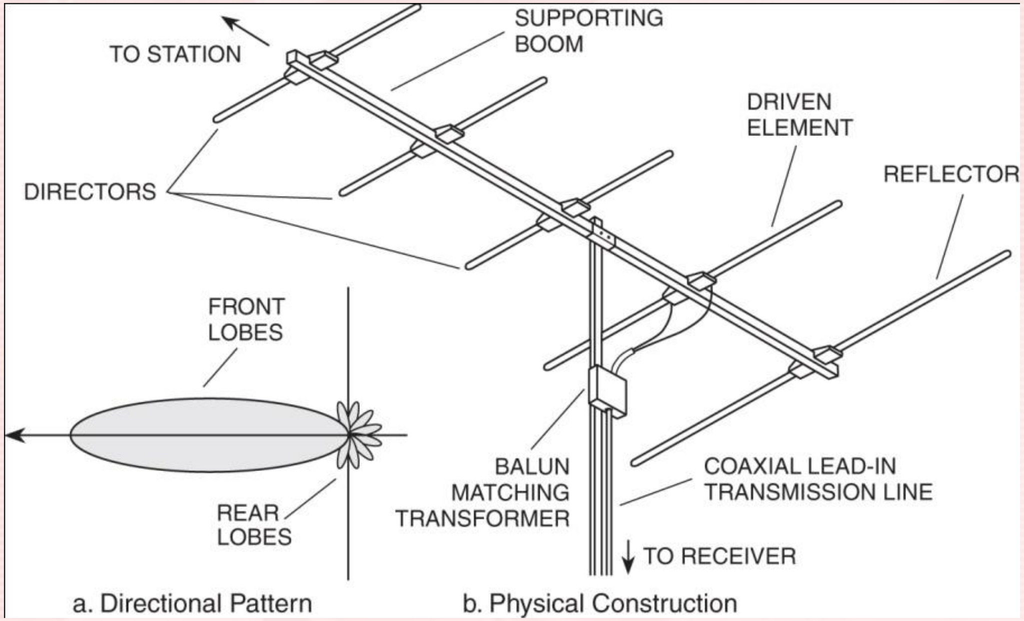
July 1, 2010 – June 30, 2014

Amateur Radio Technician Class Element 2 Course Presentation

- **ELEMENT 2 SUB-ELEMENTS**
  - T1 - FCC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities.
  - **T2 – Operating Procedures**
  - **T3 – Radio wave characteristics, radio and electromagnetic properties, propagation modes**
  - **T4 – Amateur radio practices and station set up**
  - **T5 – Electrical principles, math for electronics, electronic principles, Ohm's Law**
  - **T6 – Electrical components, semiconductors, circuit diagrams, component functions**
  - **T7 – Station equipment, common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing**
  - **T8 – Modulation modes, amateur satellite operation, operating activities, non-voice communications**
  - **T9 – Antennas, feedlines**
  - **T0 – AC power circuits, antenna installation, RF hazards**

T9A: Antennas; vertical and horizontal, concept of gain, common portable and mobile antennas, relationships between antenna length and frequency

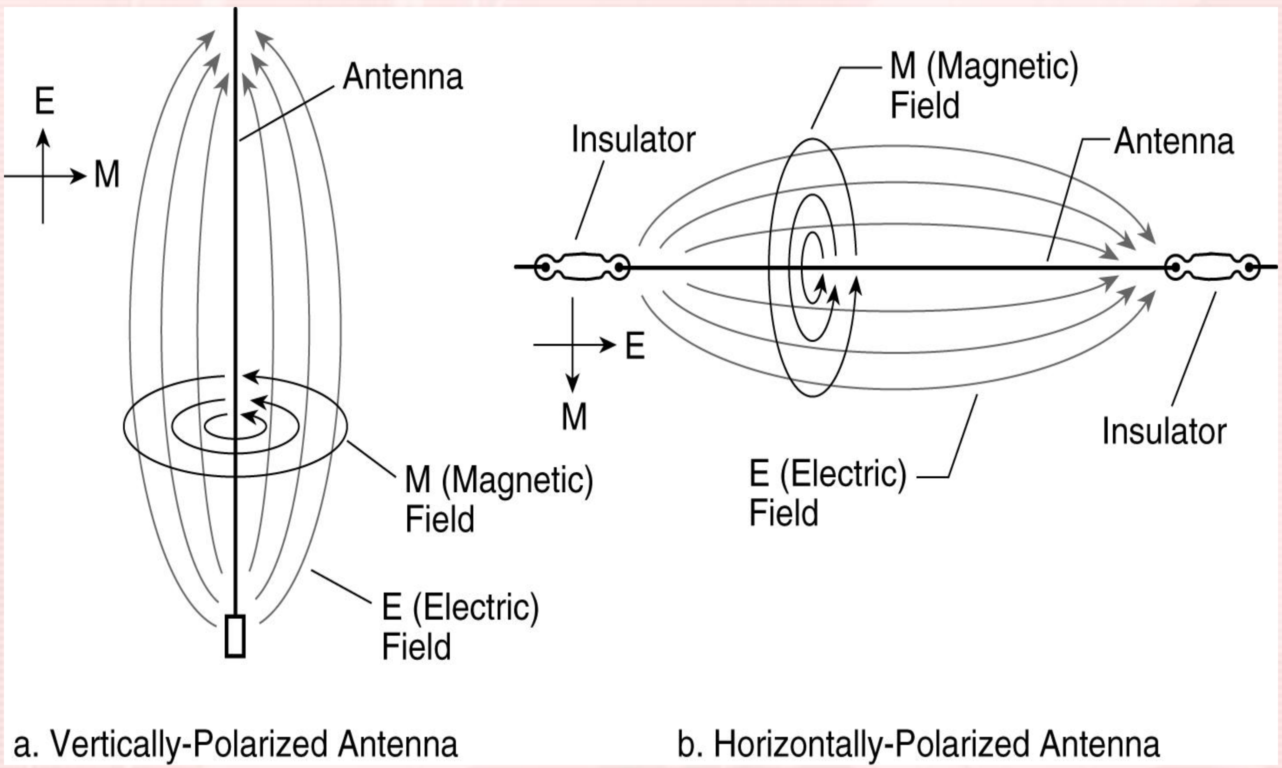
- T9A1 A beam antenna concentrates signals in one direction



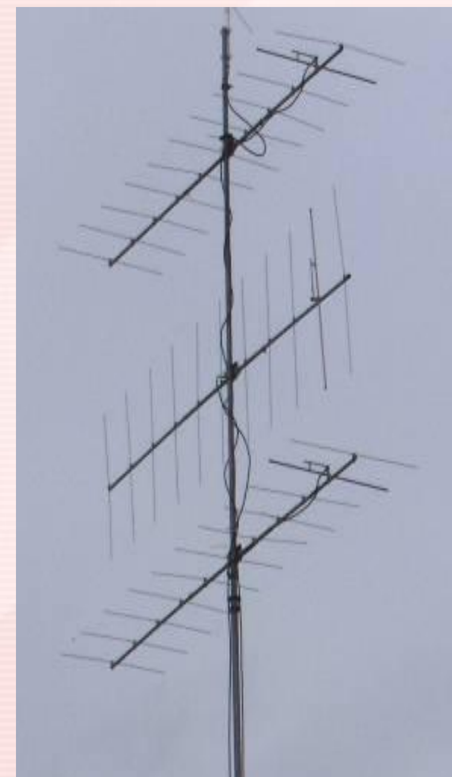
A Beam Antenna – The Yagi Antenna

T9A: Antennas; vertical and horizontal, concept of gain, common portable and mobile antennas, relationships between antenna length and frequency

- T9A2 The electric field of vertical antennas is perpendicular to the Earth.



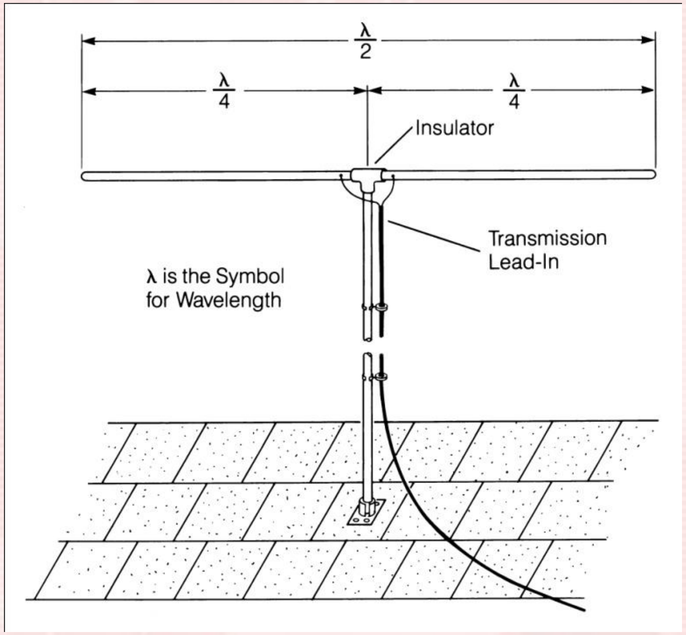
Vertical and Horizontal Polarization



H & V Polarized Antennas

T9A: Antennas; vertical and horizontal, concept of gain, common portable and mobile antennas, relationships between antenna length and frequency

- T9A3 A simple dipole mounted so the conductor is parallel to the Earth's surface is a horizontally polarized antenna.

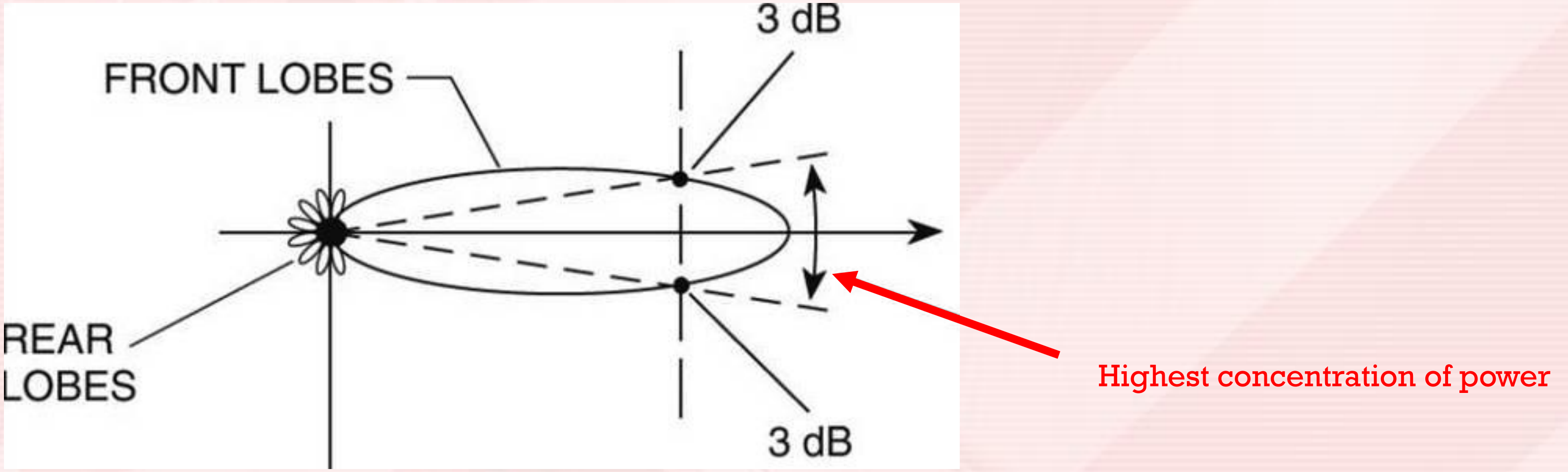


Simple Dipole

Three element beam

T9A: Antennas; vertical and horizontal, concept of gain, common portable and mobile antennas, relationships between antenna length and frequency

- T9A4 A disadvantage of the "rubber duck" antenna supplied with most handheld radio transceivers is that it does not transmit or receive as effectively as a full-sized antenna.
- T9A5 You would change a dipole antenna to make it resonant on a higher frequency by making it shorter..
- T9A6 Directional antennas are the quad, Yagi, and dish.



Directional Radiation Pattern of a Yagi Beam

T9A: Antennas; vertical and horizontal, concept of gain, common portable and mobile antennas, relationships between antenna length and frequency

- T9A7 A good reason not to use a "rubber duck" antenna inside your car is that signals can be significantly weaker than when it is outside of the vehicle.

Modern dual- and tri-band handheld tranceivers like these have amazing built-in capabilities that make ham radio easy, fun, and portable.

T9A: Antennas; vertical and horizontal, concept of gain, common portable and mobile antennas, relationships between antenna length and frequency

- T9A8 The approximate length of a quarter-wavelength vertical antenna for 146 MHz is 19 inches.

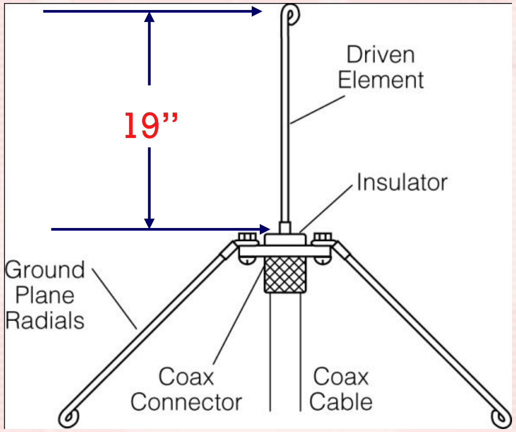
$$\text{Length of vertical in feet} = \frac{234}{f\ (\text{MHz})}$$

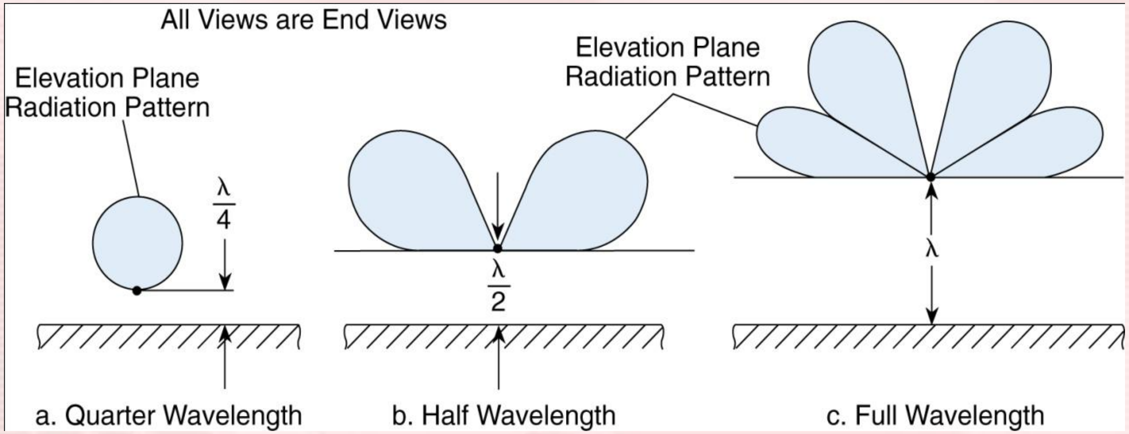
(for quarter-wave dipole)

(2-meters is 144-148 MHz)

Feet = 234/146 = 1.6

1.6 x 12 = 19 inches





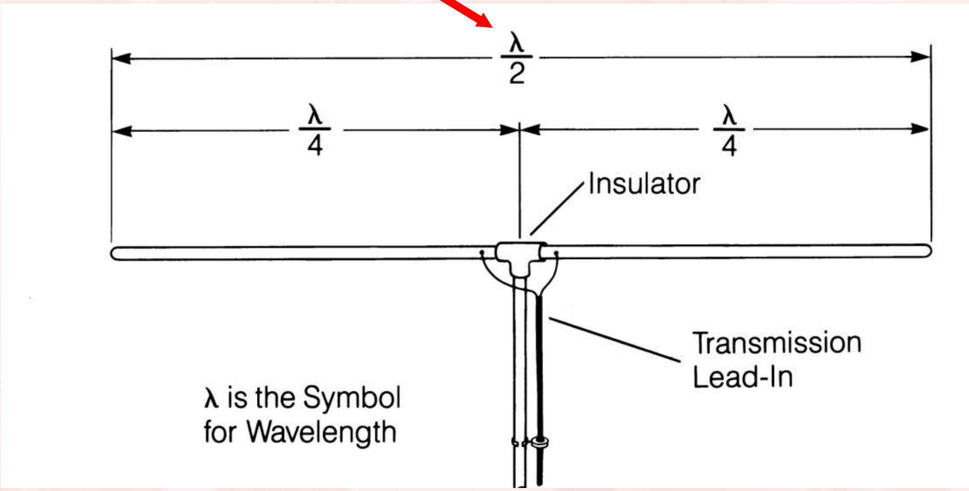
Radiation Pattern of an Antenna Changes as Height Above Ground is Varied

T9A: Antennas; vertical and horizontal, concept of gain, common portable and mobile antennas, relationships between antenna length and frequency

- T9A9 The approximate length of a 6 meter 1/2-wavelength wire dipole antenna is 112 inches.

112 inches

Length of vertical in feet = $\frac{468}{f\ (MHz)}$
(for half-wave dipole)



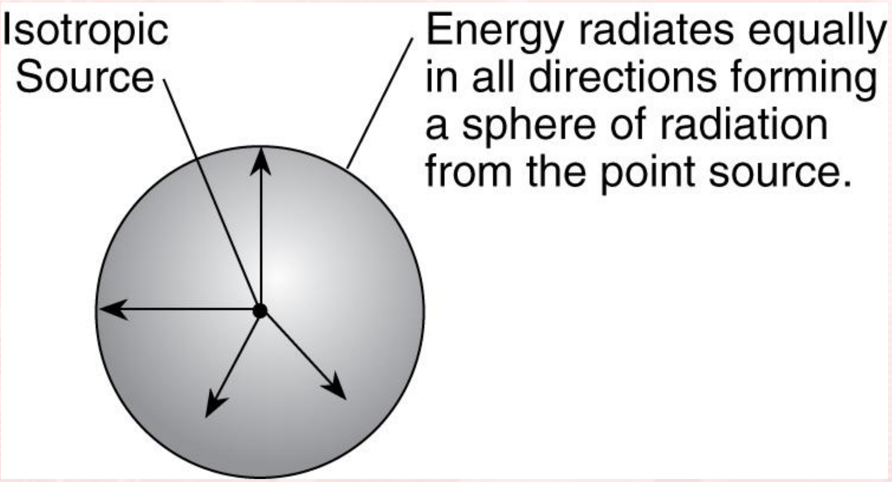
Feet = 468/50 = 9.36

9.36 x 12 = 112.3 inches

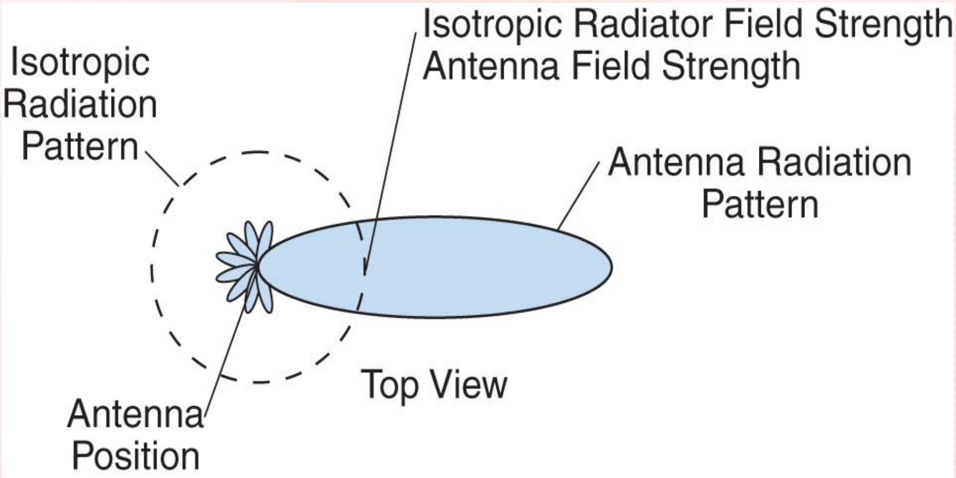
Six Meter ½ Wavelength Dipole

T9A10 The strongest radiation from a half-wave dipole antenna in free space is broadside to the antenna.

- T9A11 The gain of an antenna is the increase in signal strength in a specified direction when compared to a reference antenna.



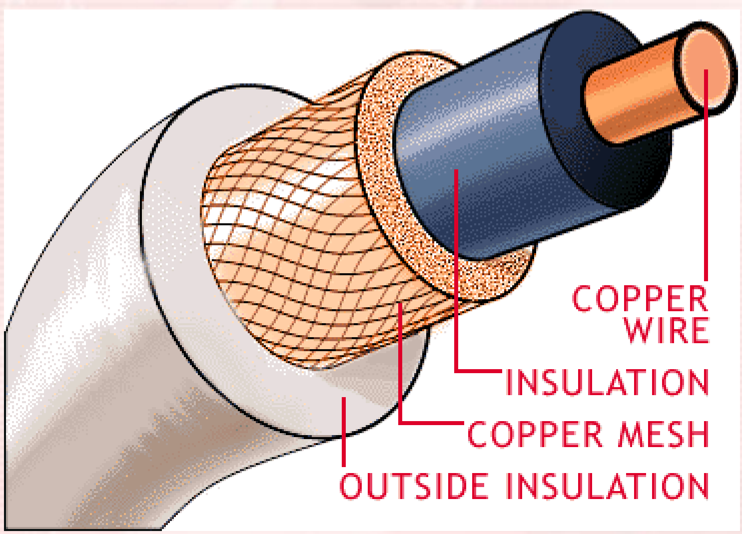
Isotropic Radiator Pattern

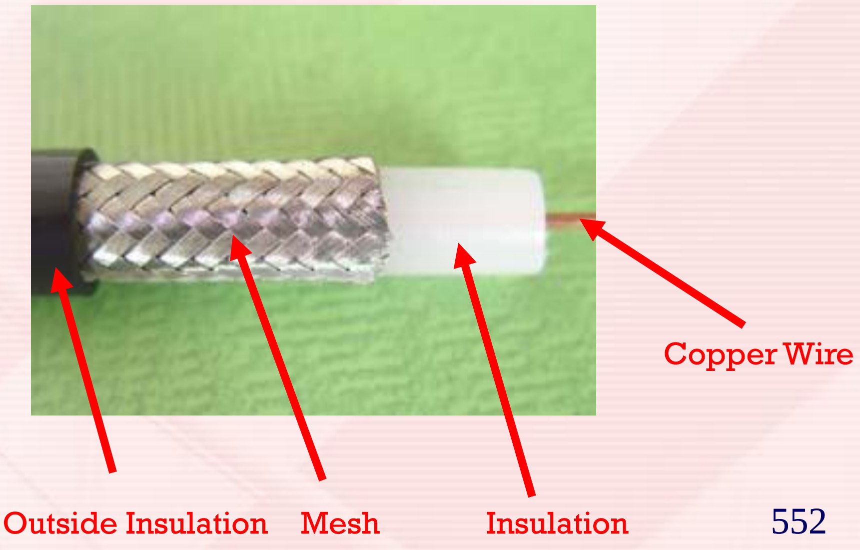


"Gain" of an antenna

T9B: Feedlines; types, losses vs. frequency, SWR concepts, matching weather protection, connectors.

- T9B1 It is important to have a low SWR in an antenna system that uses coaxial cable feedline to provide efficient transfer of power and reduce losses.
- T9B2 50 ohms is the impedance of the most commonly used coaxial cable in typical amateur radio installations.
- T9B3 Coaxial cable is used more often than any other feedline for amateur radio antenna systems because it is easy to use and requires few special installation considerations.





- T9B4 An antenna tuner matches the antenna system impedance to the transceiver's output impedance.

MFJ-971 Portable QRP 200 Watt Tuner

Icom 7000 with LDG 7000 Auto-Tuner

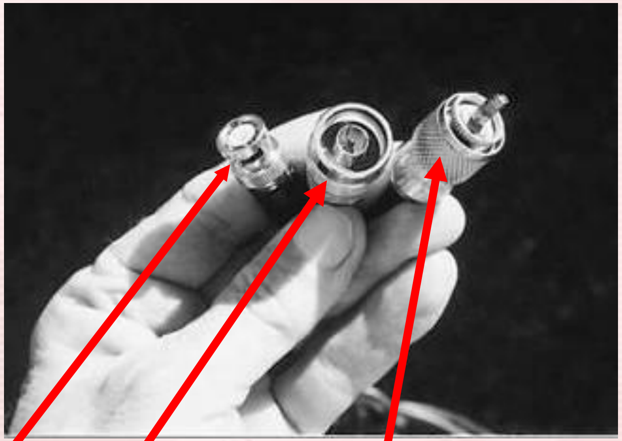
Miracle QPak 50 Watt Manual Tuner

Palstar 1500 Watt Auto-Tuner

MFJ-994B 1500 Watt Auto-Tuner

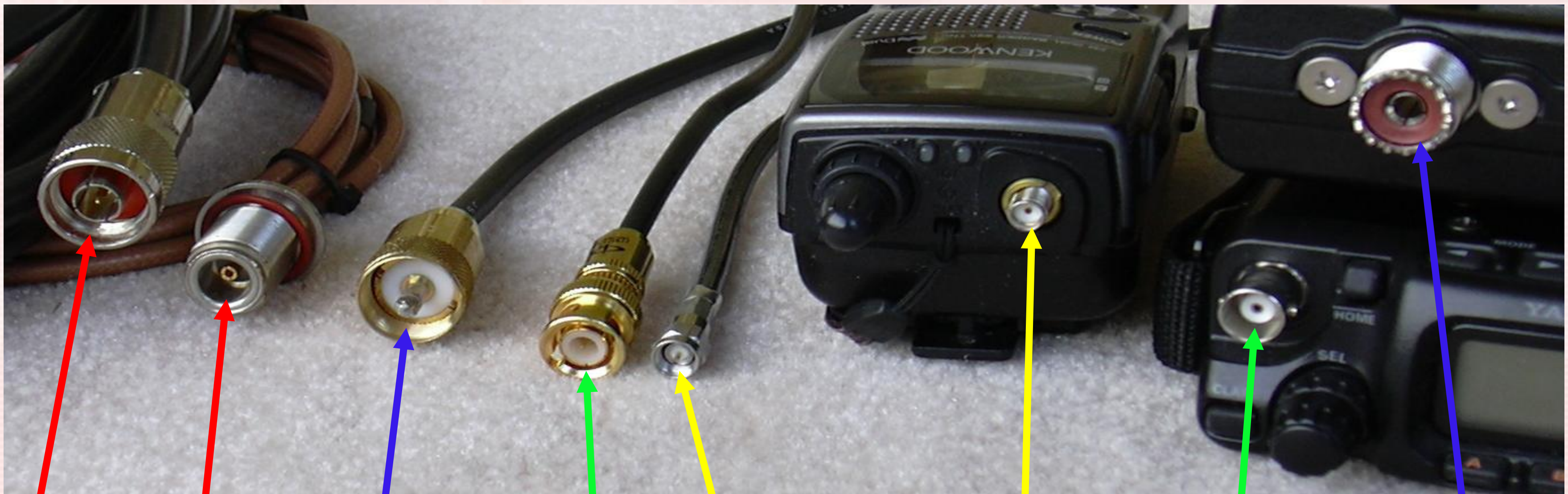
T9B: Feedlines; types, losses vs. frequency, SWR concepts, matching weather protection, connectors.

- T9B5 As the frequency of a signal passing through coaxial cable is increased the loss increases.
  - The Higher the frequency the more the loss
- T9B6 A Type N connector is most suitable for frequencies above 400 MHz?
- T9B7 PL-259 type coax connectors are commonly used at HF frequencies.



BNC, Type N, and PL 259 Connectors

T9B: Feedlines; types, losses vs. frequency, SWR concepts, matching weather protection, connectors.



N Male	N Female	Male VHF PL-259	Male BNC	Male SMA	Female SMA	Female BNC	Female SO-239

Understand the type of connector on your radio
You may need an adapter from your coax connector to your radio

Never buy cheap coax, connectors, or adapters

T9B: Feedlines; types, losses vs. frequency, SWR concepts, matching weather protection, connectors.

- T9B8 Coax connectors exposed to the weather should be sealed against water intrusion to prevent an increase in feedline loss.

- T9B9 A loose connection in an antenna or a feedline might cause erratic changes in SWR readings.

Make sure all coax connections are tight to help minimize interference

T9B: Feedlines; types, losses vs. frequency, SWR concepts, matching weather protection, connectors.

- T9B10 Electrical differences exists between the smaller RG-58 and larger RG-8 coaxial cables in that RG-8 cable has less loss at a given frequency.

Coax Cable Type, Size, and Loss per 100 feet

Coax Type	Size	@ 100 MHz	@ 400 MHz
RG-58U	Small	4.3 dB	9.4 dB
RG-8X	Medium	3.7 dB	8.0 dB
RG-8U	Large	1.9 dB	4.1 dB
RG-213	Large	1.9 dB	4.5 dB
Hardline	Large, Rigid	0.5 dB	1.5 dB

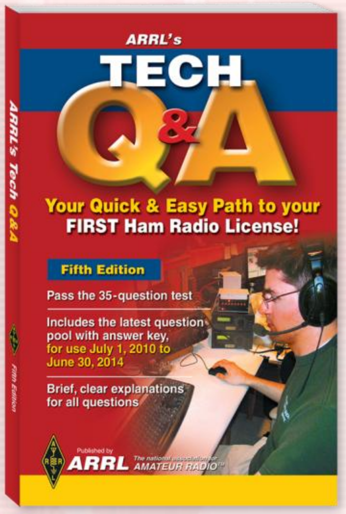
- T9B11 The lowest loss feedline at VHF and UHF is an Air-insulated hard line..

T9B: Feedlines; types, losses vs. frequency, SWR concepts, matching weather protection, connectors.

Coax Cable Signal Loss (Attenuation) in dB per 100ft								
Loss	RG-174	RG-58	RG-8X	RG-213	RG-6	RG-11	9913	LMR-400
1MHz	1.9dB	0.4dB	0.5dB	0.2dB	0.2dB	0.2dB	0.2dB	0.3dB
10MHz	3.3dB	1.4dB	1.0dB	0.6dB	0.6dB	0.4dB	0.4dB	0.5dB
50MHz	6.6dB	3.3dB	2.5dB	1.6dB	1.4dB	1.0dB	0.9dB	0.9dB
100MHz	8.9dB	4.9dB	3.6dB	2.2dB	2.0dB	1.6dB	1.4dB	1.4dB
200MHz	11.9dB	7.3dB	5.4dB	3.3dB	2.8dB	2.3dB	1.8dB	1.8dB
400MHz	17.3dB	11.2dB	7.9dB	4.8dB	4.3dB	3.5dB	2.6dB	2.6dB
700MHz	26.0dB	16.9dB	11.0dB	6.6dB	5.6dB	4.7dB	3.6dB	3.5dB
900MHz	27.9dB	20.1dB	12.6dB	7.7dB	6.0dB	5.4dB	4.2dB	3.9dB
1GHz	32.0dB	21.5dB	13.5dB	8.3dB	6.1dB	5.6dB	4.5dB	4.1dB
Imped	50ohm	50ohm	50ohm	50ohm	75ohm	75ohm	50ohm	50ohm

Element 2 Technician Class Question Pool

T9
Antennas, feedlines
[2 Exam Questions – 2 Groups]



Valid July 1, 2010

Through

June 30, 2014

T9A01 What is a beam antenna?

A. An antenna built from aluminum I-beams
B. An omnidirectional antenna invented by Clarence Beam
C. An antenna that concentrates signals in one direction
D. An antenna that reverses the phase of received signals

T9A02 Which of the following is true regarding vertical antennas?

A. The magnetic field is perpendicular to the Earth
B. The electric field is perpendicular to the Earth
C. The phase is inverted
D. The phase is reversed

T9A03 Which of the following describes a simple dipole mounted so the conductor is parallel to the Earth's surface?

A. A ground wave antenna
B. A horizontally polarized antenna
C. A rhombic antenna
D. A vertically polarized antenna

T9A04 What is a disadvantage of the "rubber duck" antenna supplied with most handheld radio transceivers?

A. It does not transmit or receive as effectively as a full-sized antenna
B. It transmits a circularly polarized signal
C. If the rubber end cap is lost it will unravel very quickly
D. All of these choices are correct

T9A05 How would you change a dipole antenna to make it resonant on a higher frequency?

A. Lengthen it
B. Insert coils in series with radiating wires
C. Shorten it
D. Add capacity hats to the ends of the radiating wires

T9A06 What type of antennas are the quad, Yagi, and dish?

A. Non-resonant antennas
B. Loop antennas
C. Directional antennas
D. Isotropic antennas

T9A07 What is a good reason not to use a "rubber duck" antenna inside your car?

A. Signals can be significantly weaker than when it is outside of the vehicle
B. It might cause your radio to overheat
C. The SWR might decrease, decreasing the signal strength
D. All of these choices are correct

T9A08 What is the approximate length, in inches, of a quarter-wavelength vertical antenna for 146 MHz?

A. 112
B. 50
C. 19
D. 12

T9A09 What is the approximate length, in inches, of a 6 meter 1/2-wavelength wire dipole antenna?

A. 6
B. 50
C. 112
D. 236

T9A10 In which direction is the radiation strongest from a half-wave dipole antenna in free space?

A. Equally in all directions
B. Off the ends of the antenna
C. Broadside to the antenna
D. In the direction of the feedline

T9A11 What is meant by the gain of an antenna?

A. The additional power that is added to the transmitter power

B. The additional power that is lost in the antenna when transmitting on a higher frequency

C. The increase in signal strength in a specified direction when compared to a reference antenna

D. The increase in impedance on receive or transmit compared to a reference antenna

T9B01 Why is it important to have a low SWR in an antenna system that uses coaxial cable feedline?

A. To reduce television interference
B. To allow the efficient transfer of power and reduce losses
C. To prolong antenna life
D. All of these choices are correct

T9B02 What is the impedance of the most commonly used coaxial cable in typical amateur radio installations?

A. 8 ohms
B. 50 ohms
C. 600 ohms
D. 12 ohms

T9B03 Why is coaxial cable used more often than any other feedline for amateur radio antenna systems?

A. It is easy to use and requires few special installation considerations
B. It has less loss than any other type of feedline
C. It can handle more power than any other type of feedline
D. It is less expensive than any other types of feedline

T9B04 What does an antenna tuner do?

A. It matches the antenna system impedance to the transceiver's output impedance
B. It helps a receiver automatically tune in weak stations
C. It allows an antenna to be used on both transmit and receive
D. It automatically selects the proper antenna for the frequency band being used

T9B05 What generally happens as the frequency of a signal passing through coaxial cable is increased?

A. The apparent SWR increases
B. The reflected power increases
C. The characteristic impedance increases
D. The loss increases

T9B06 Which of the following connectors is most suitable for frequencies above 400 MHz?

A. A UHF (PL-259/SO-239) connector
B. A Type N connector
C. An RS-213 connector
D. A DB-23 Connector

T9B07 Which of the following is true of PL-259 type coax connectors?

A. They are good for UHF frequencies
B. They are water tight
C. The are commonly used at HF frequencies
D. They are a bayonet type connector

T9B08 Why should coax connectors exposed to the weather be sealed against water intrusion?

A. To prevent an increase in feedline loss
B. To prevent interference to telephones
C. To keep the jacket from becoming loose
D. All of these choices are correct

T9B09 What might cause erratic changes in SWR readings?

A. The transmitter is being modulated
B. A loose connection in an antenna or a feedline
C. The transmitter is being over-modulated
D. Interference from other stations is distorting your signal

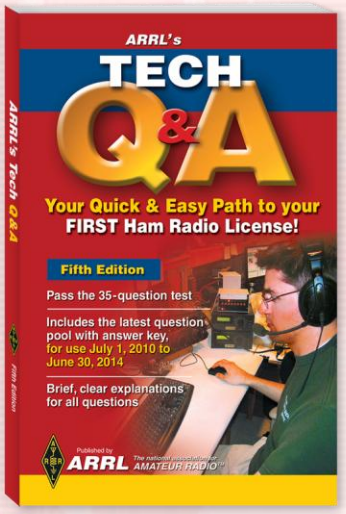
T9B10 What electrical difference exists between the smaller RG-58 and larger RG-8 coaxial cables?

A. There is no significant difference between the two types
B. RG-58 cable has less loss at a given frequency
C. RG-8 cable has less loss at a given frequency
D. RG-58 cable can handle higher power levels

T9B11 Which of the following types of feedline has the lowest loss at VHF and UHF?

A. 50-ohm flexible coax
B. Multi-conductor unbalanced cable
C. Air-insulated hard line
D. 75-ohm flexible coax

Technician Licensing Class
“T0”



Valid dates:

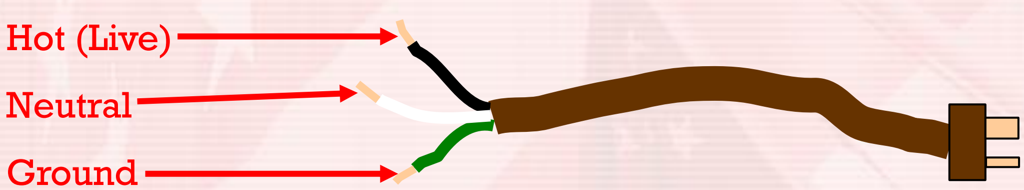
July 1, 2010 – June 30, 2014

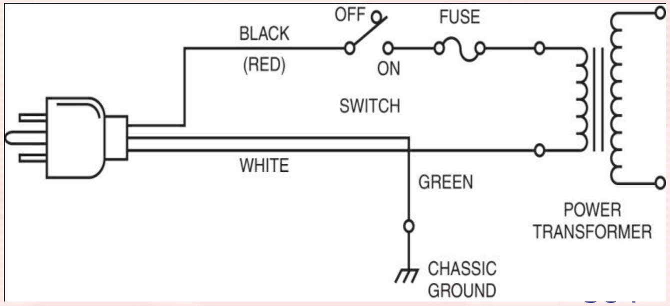
Amateur Radio Technician Class
Element 2 Course Presentation

- **ELEMENT 2 SUB-ELEMENTS**
  - **T1 - FCC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities.**
  - **T2 – Operating Procedures**
  - **T3 – Radio wave characteristics, radio and electromagnetic properties, propagation modes**
  - **T4 – Amateur radio practices and station set up**
  - **T5 – Electrical principles, math for electronics, electronic principles, Ohm's Law**
  - **T6 – Electrical components, semiconductors, circuit diagrams, component functions**
  - **T7 – Station equipment, common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing**
  - **T8 – Modulation modes, amateur satellite operation, operating activities, non-voice communications**
  - **T9 – Antennas, feedlines**
  - T0 – AC power circuits, antenna installation, RF hazards

T0A: AC power circuits; hazardous voltages, fuses and circuit breakers, grounding, lightning protection, battery safety, electrical code compliance.

- T0A1 A commonly accepted value for the lowest voltage that can cause a dangerous electric shock is 30 volts.
- T0A2 Current flowing through the body cause a health hazard:
  - By heating tissue;
  - It disrupts the electrical functions of cells;
  - It causes involuntary muscle contractions.
- T0A3 The green wire in a three-wire electrical AC plug is safety ground.





AC Line Connections

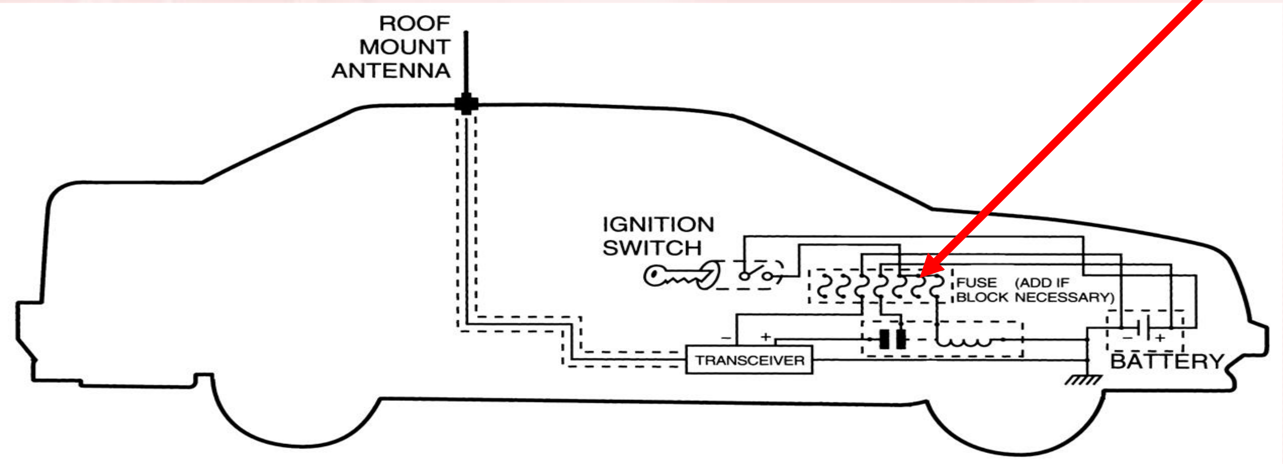
T0A: AC power circuits; hazardous voltages, fuses and circuit breakers, grounding, lightning protection, battery safety, electrical code compliance.

- T0A4 The purpose of a fuse in an electrical circuit is to interrupt power in case of overload.

Slow-Blow fuse

Automobile fuse

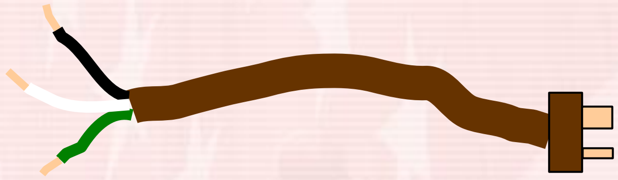
Fuses

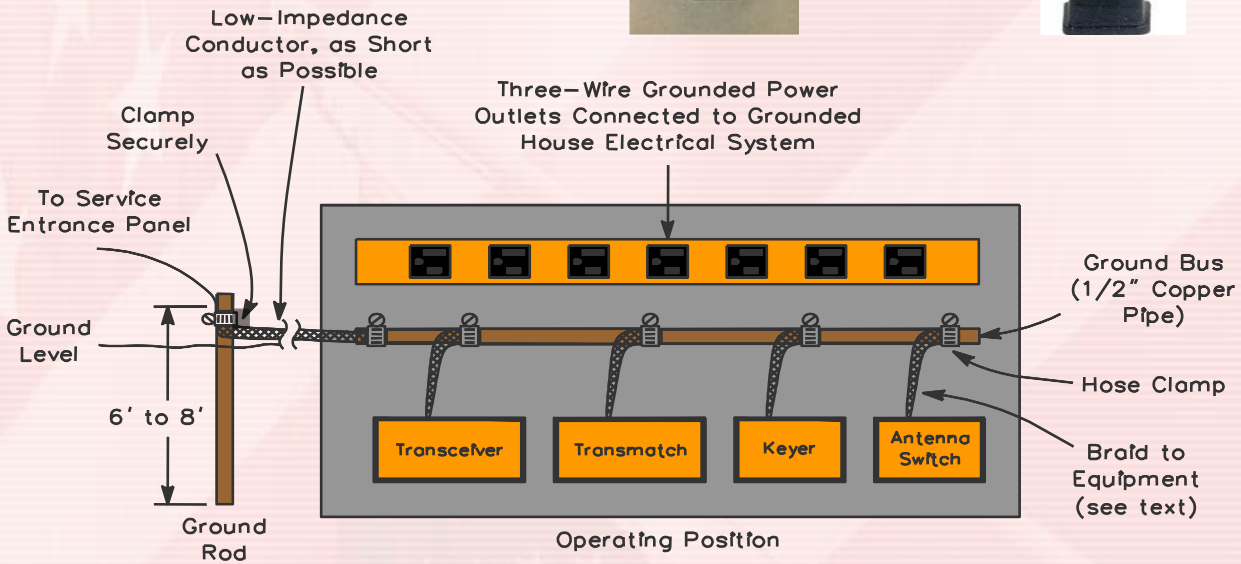


Place the fuses as close to the battery as possible

T0A: AC power circuits; hazardous voltages, fuses and circuit breakers, grounding, lightning protection, battery safety, electrical code compliance.

- T0A5 It is unwise to install a 20-ampere fuse in the place of a 5-ampere fuse because excessive current could cause a fire.
- T0A6 A good way to guard against electrical shock at your station:
  - Use three-wire cords and plugs for all AC powered equipment;



- T0A7 Precautions should be taken when installing devices for lightning protection in a coaxial cable feedline by grounding all of the protectors to a common plate which is in turn connected to an external ground.
    - Good for nearby lightning strikes
    - Direct hits, forget it, kiss everything goodbye for good

- T0A8 One way to recharge a 12-volt lead-acid station battery if the commercial power is out is to connect the battery to a car's battery and run the engine.

T0A: AC power circuits; hazardous voltages, fuses and circuit breakers, grounding, lightning protection, battery safety, electrical code compliance.

- T0A9 A hazard is presented by a conventional 12-volt storage battery with its explosive gas that can collect if not properly vented.
    - Dangerous acid could spill
    - Enough power to cause a fire
- T0A10 If a lead-acid storage battery is charged or discharged too quickly it could overheat and give off flammable gas or explode.
- T0A11 A good practice when installing ground wires on a tower for lightning protection is to ensure that connections are short and direct.

T0B: Antenna installation; tower safety, overhead power lines.

- T0B1 Members of a tower work team should wear a hard hat and safety glasses at all times when any work is being done on the tower.
    - On ground or up the tower
    - Wear hard hat and safety glasses
- T0B2 Putting on a climbing harness and safety glasses is a good precaution to observe before climbing an antenna tower.

Climbing Harness

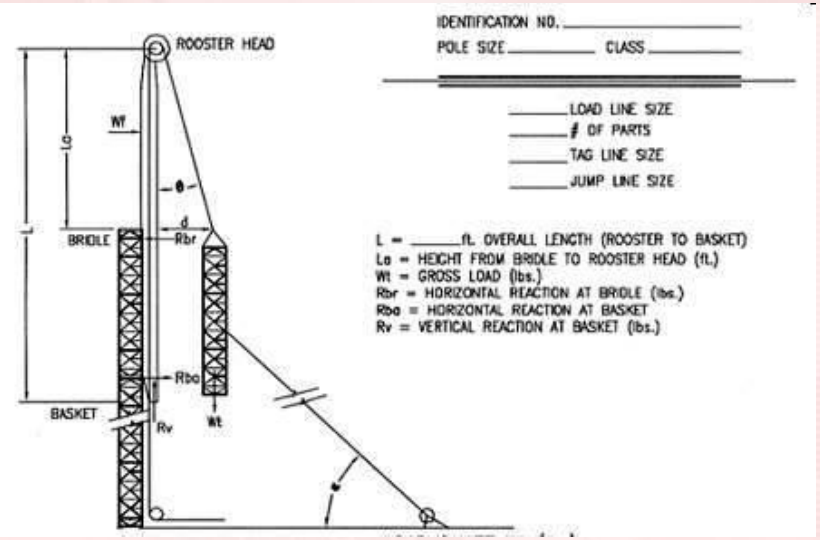
Safety Glasses

And

Hard Hat

T0B: Antenna installation; tower safety, overhead power lines.

- T0B3 It is never safe to climb a tower without a helper or observer.
  - Never work on a tower without a helper
- T0B4 Looking for and staying clear of any overhead electrical wires is an important safety precaution to observe when putting up an antenna tower.
  - Overhead electrical wires carry more than 120 VAC
  - Use common sense and think safety first
- T0B5 The purpose of a gin pole is to lift tower sections or antennas.



T0B: Antenna installation; tower safety, overhead power lines.

- T0B6 The minimum safe distance to allow from a power line when installing an antenna so that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires.
  - This is a ‘minimum’ distance
- T0B7 An important safety rule to remember when using a crank-up tower is that this type of tower must never be climbed unless it is in the fully retracted position.
  - Think weight overload and **never** climb a cranked up tower
- T0B8 Proper grounding method for a tower is to have separate eight-foot long ground rods for each tower leg, bonded to the tower and each other.

T0B: Antenna installation; tower safety, overhead power lines.

- T0B9 You should avoid attaching an antenna to a utility pole as the antenna could contact high-voltage power wires.
  - And it may be illegal to do
- T0B10 Concerning grounding conductors used for lightning protection, sharp bends must be avoided.
- T0B11 Grounding requirements for an amateur radio tower or antenna are established by local electrical codes
  - Always wear hard hat and safety glasses
  - Check local codes before putting up an antenna

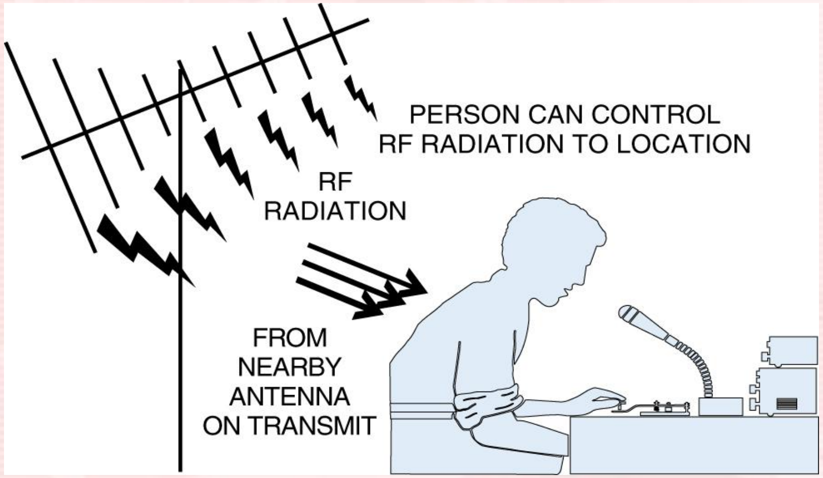
T0C: RF hazards; radiation exposure, proximity to antennas, recognized safe power levels, exposure to others.

- T0C1 VHF and UHF radio signals are non-ionizing radiation.
  - Quite different from X-ray, gamma ray, and ultra violet radiation
- T0C2 With 3.5 MHz, 50 MHz, 440 MHz, and 1296 MHz; a 50 MHz frequency has the lowest Maximum Permissible Exposure limit.
- T0C3 The maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required is 50 watts PEP at the antenna.

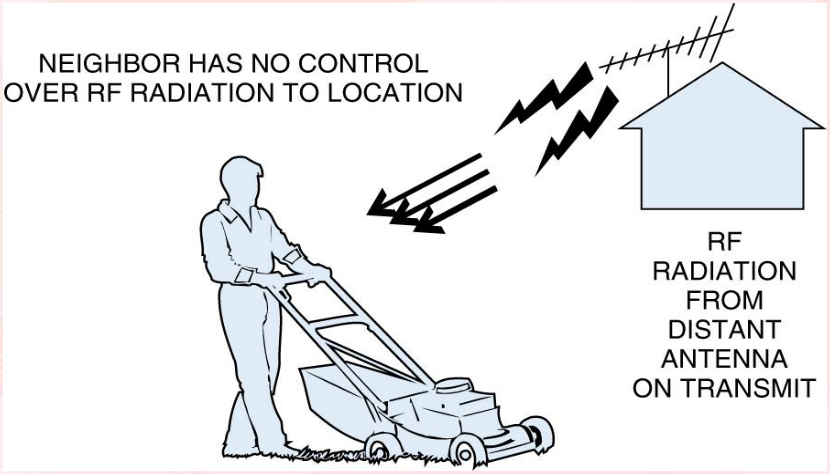
Never stand in front of a microwave feedhorn antenna.

On transmit, it radiates a concentrated beam of RF energy.

- T0C4 Factors affecting the RF exposure of people near an amateur station antenna:
    - Frequency and power level of the RF field
    - Distance from the antenna to a person
    - Radiation pattern of the antenna



Controlled



Uncontrolled

T0C: RF hazards; radiation exposure, proximity to antennas, recognized safe power levels, exposure to others.

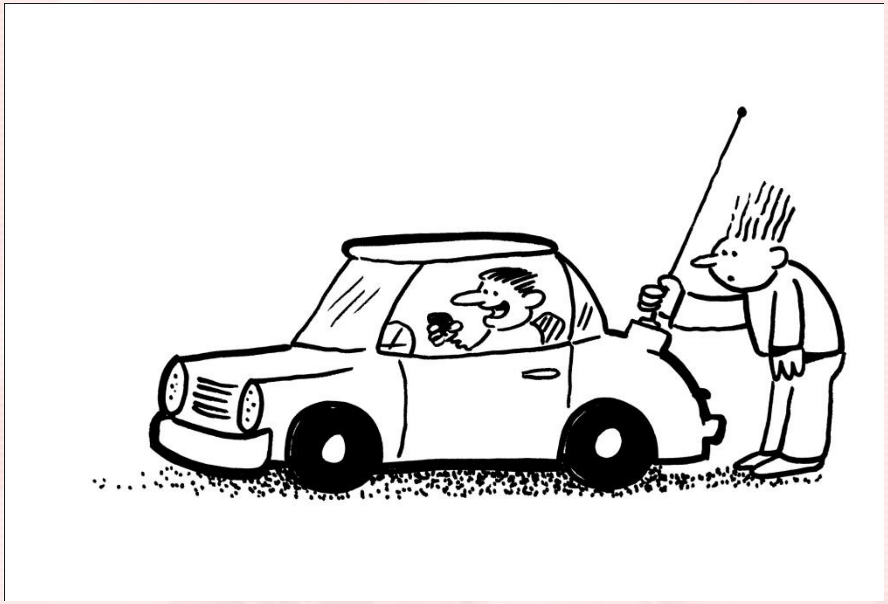
- T0C5 Exposure limits vary with frequency because the human body absorbs more RF energy at some frequencies than at others.

- T0C6 Acceptable methods to determine that your station complies with FCC RF exposure regulations:

  - By calculation based on FCC OET Bulletin 65
  - By calculation based on computer modeling
  - By measurement of field strength using calibrated equipment

T0C: RF hazards; radiation exposure, proximity to antennas, recognized safe power levels, exposure to others.

- T0C7 If a person accidentally touched your antenna while you were transmitting they might receive a painful RF burn.
  - Accidentally or on purpose, depending on the power too.



Be sure to place your antennas where no one can touch them. All antennas, not just the mobile ones.

T0C: RF hazards; radiation exposure, proximity to antennas, recognized safe power levels, exposure to others.

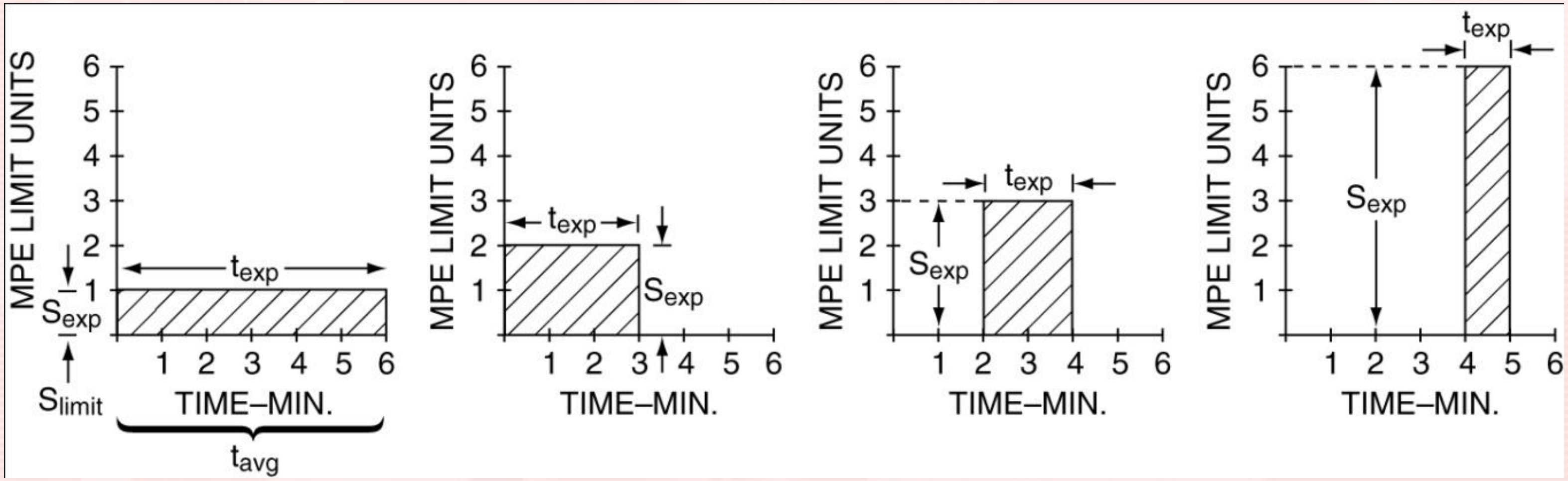
- T0C8 An action amateur operators might take to prevent exposure to RF radiation in excess of FCC-supplied limits is to relocate antennas.

The safest place to mount the mobile antenna for minimum RF exposure is on the metal roof as shown.

- T0C9 To make sure your station stays in compliance with RF safety regulations, re-evaluate the station whenever an item of equipment is changed.

T0C: RF hazards; radiation exposure, proximity to antennas, recognized safe power levels, exposure to others.

- T0C10 Duty cycle is one of the factors used to determine safe RF radiation exposure levels because it affects the average exposure of people to radiation.

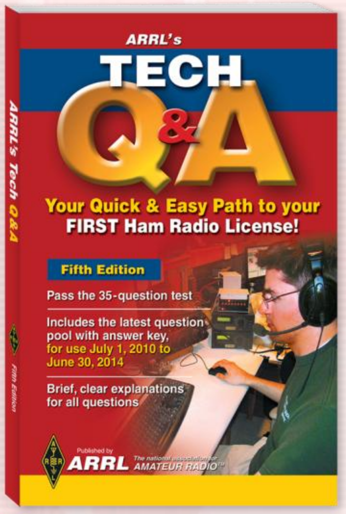


- T0C11 When referring to RF exposure, "duty cycle" is the ratio of "on-air" time of a transmitted signal to the total time.

Element 2 Technician Class Question Pool

T0

AC power circuits, antenna installation, RF hazards
[3 Exam Questions – 3 Groups]



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T0A01 Which is a commonly accepted value for the lowest voltage that can cause a dangerous electric shock?

A. 12 volts
B. 30 volts
C. 120 volts
D. 300 volts

T0A02 How does current flowing through the body cause a health hazard?

A. By heating tissue
B. It disrupts the electrical functions of cells
C. It causes involuntary muscle contractions
D. All of these choices are correct

T0A03 What is connected to the green wire in a three-wire electrical AC plug?

A. Neutral
B. Hot
C. Safety ground
D. The white wire

T0A04 What is the purpose of a fuse in an electrical circuit?

A. To prevent power supply ripple from damaging a circuit
B. To interrupt power in case of overload
C. To limit current to prevent shocks
D. All of these choices are correct

T0A05 Why is it unwise to install a 20-ampere fuse in the place of a 5-ampere fuse?

A. The larger fuse would be likely to blow because it is rated for higher current
B. The power supply ripple would greatly increase
C. Excessive current could cause a fire
D. All of these choices are correct

T0A06 What is a good way to guard against electrical shock at your station?

A. Use three-wire cords and plugs for all AC powered equipment
B. Connect all AC powered station equipment to a common safety ground
C. Use a circuit protected by a ground-fault interrupter
D. All of these choices are correct

T0A07 Which of these precautions should be taken when installing devices for lightning protection in a coaxial cable feedline?

A. Include a parallel bypass switch for each protector so that it can be switched out of the circuit when running high power
B. Include a series switch in the ground line of each protector to prevent RF overload from inadvertently damaging the protector
C. Keep the ground wires from each protector separate and connected to station ground
D. Ground all of the protectors to a common plate which is in turn connected to an external ground

T0A08 What is one way to recharge a 12-volt lead-acid station battery if the commercial power is out?

A. Cool the battery in ice for several hours
B. Add acid to the battery
C. Connect the battery to a car's battery and run the engine
D. All of these choices are correct

T0A09 What kind of hazard is presented by a conventional 12-volt storage battery?

A. It emits ozone which can be harmful to the atmosphere
B. Shock hazard due to high voltage
C. Explosive gas can collect if not properly vented
D. All of these choices are correct

T0A10 What can happen if a lead-acid storage battery is charged or discharged too quickly?

A. The battery could overheat and give off flammable gas or explode
B. The voltage can become reversed
C. The “memory effect” will reduce the capacity of the battery
D. All of these choices are correct

T0A11 Which of the following is good practice when installing ground wires on a tower for lightning protection?

A. Put a loop in the ground connection to prevent water damage to the ground system
B. Make sure that all bends in the ground wires are clean, right angle bends
C. Ensure that connections are short and direct
D. All of these choices are correct

T0A12 What kind of hazard might exist in a power supply when it is turned off and disconnected?

A. Static electricity could damage the grounding system
B. Circulating currents inside the transformer might cause damage
C. The fuse might blow if you remove the cover
D. You might receive an electric shock from stored charge in large capacitors

T0A13 What safety equipment should always be included in home-built equipment that is powered from 120V AC power circuits?

A. A fuse or circuit breaker in series with the AC "hot" conductor
B. An AC voltmeter across the incoming power source
C. An inductor in series with the AC power source
D. A capacitor across the AC power source

T0B01 When should members of a tower work team wear a hard hat and safety glasses?

A. At all times except when climbing the tower

B. At all times except when belted firmly to the tower

C. At all times when any work is being done on the tower

D. Only when the tower exceeds 30 feet in height

T0B02 What is a good precaution to observe before climbing an antenna tower?

A. Make sure that you wear a grounded wrist strap
B. Remove all tower grounding connections
C. Put on a climbing harness and safety glasses
D. All of the these choices are correct

T0B03 Under what circumstances is it safe to climb a tower without a helper or observer?

A. When no electrical work is being performed
B. When no mechanical work is being performed
C. When the work being done is not more than 20 feet above the ground
D. Never

T0B04 Which of the following is an important safety precaution to observe when putting up an antenna tower?

A. Wear a ground strap connected to your wrist at all times
B. Insulate the base of the tower to avoid lightning strikes
C. Look for and stay clear of any overhead electrical wires
D. All of these choices are correct

T0B05 What is the purpose of a gin pole?

A. To temporarily replace guy wires
B. To be used in place of a safety harness
C. To lift tower sections or antennas
D. To provide a temporary ground

T0B06 What is the minimum safe distance from a power line to allow when installing an antenna?

A. Half the width of your property
B. The height of the power line above ground
C. 1/2 wavelength at the operating frequency
D. So that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires

T0B07 Which of the following is an important safety rule to remember when using a crank-up tower?

A. This type of tower must never be painted
B. This type of tower must never be grounded
C. This type of tower must never be climbed unless it is in the fully retracted position
D. All of these choices are correct

T0B08 What is considered to be a proper grounding method for a tower?

A. A single four-foot ground rod, driven into the ground no more than 12 inches from the base

B. A ferrite-core RF choke connected between the tower and ground

C. Separate eight-foot long ground rods for each tower leg, bonded to the tower and each other

D. A connection between the tower base and a cold water pipe

T0B09 Why should you avoid attaching an antenna to a utility pole?

A. The antenna will not work properly because of induced voltages
B. The utility company will charge you an extra monthly fee
C. The antenna could contact high-voltage power wires
D. All of these choices are correct

T0B10 Which of the following is true concerning grounding conductors used for lightning protection?

A. Only non-insulated wire must be used
B. Wires must be carefully routed with precise right-angle bends
C. Sharp bends must be avoided
D. Common grounds must be avoided

T0B11 Which of the following establishes grounding requirements for an amateur radio tower or antenna?

A. FCC Part 97 Rules
B. Local electrical codes
C. FAA tower lighting regulations
D. Underwriters Laboratories' recommended practices

T0C01 What type of radiation are VHF and UHF radio signals?

A. Gamma radiation
B. Ionizing radiation
C. Alpha radiation
D. Non-ionizing radiation

T0C02 Which of the following frequencies has the lowest Maximum Permissible Exposure limit?

A. 3.5 MHz
B. 50 MHz
C. 440 MHz
D. 1296 MHz

T0C03 What is the maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required?

A. 1500 watts PEP transmitter output
B. 1 watt forward power
C. 50 watts PEP at the antenna
D. 50 watts PEP reflected power

T0C04 What factors affect the RF exposure of people near an amateur station antenna?

A. Frequency and power level of the RF field
B. Distance from the antenna to a person
C. Radiation pattern of the antenna
D. All of these choices are correct

T0C05 Why do exposure limits vary with frequency?

A. Lower frequency RF fields have more energy than higher frequency fields
B. Lower frequency RF fields do not penetrate the human body
C. Higher frequency RF fields are transient in nature
D. The human body absorbs more RF energy at some frequencies than at others

T0C06 Which of the following is an acceptable method to determine that your station complies with FCC RF exposure regulations?

A. By calculation based on FCC OET Bulletin 65
B. By calculation based on computer modeling
C. By measurement of field strength using calibrated equipment
D. All of these choices are correct

T0C07 What could happen if a person accidentally touched your antenna while you were transmitting?

A. Touching the antenna could cause television interference
B. They might receive a painful RF burn
C. They might develop radiation poisoning
D. All of these choices are correct

T0C08 Which of the following actions might amateur operators take to prevent exposure to RF radiation in excess of FCC-supplied limits?

A. Relocate antennas
B. Relocate the transmitter
C. Increase the duty cycle
D. All of these choices are correct

T0C09 How can you make sure your station stays in compliance with RF safety regulations?

A. By informing the FCC of any changes made in your station
B. By re-evaluating the station whenever an item of equipment is changed
C. By making sure your antennas have low SWR
D. All of these choices are correct

T0C10 Why is duty cycle one of the factors used to determine safe RF radiation exposure levels?

A. It affects the average exposure of people to radiation
B. It affects the peak exposure of people to radiation
C. It takes into account the antenna feedline loss
D. It takes into account the thermal effects of the final amplifier

T0C11 What is meant by "duty cycle" when referring to RF exposure?

A. The difference between lowest usable output and maximum rated output power of a transmitter
B. The difference between PEP and average power of an SSB signal
C. The ratio of "on-air" time of a transmitted signal to the total time.
D. The amount of time the operator spends transmitting