

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Technician and General Class Amateur Radio & Satellite Stuff

Anthony Odenthal, KE7OSN Amateur Extra

December 5, 2013

Welcome

Technician and
General Class
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& Satellite Stuff

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Welcome, over the next several sessions we will cover a substantial amount of information. please ask questions and slow me down.

The goals are:

- To introduce you to Amateur Radio

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General Class
Amateur Radio
& Satellite Stuff

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Welcome, over the next several sessions we will cover a substantial amount of information. please ask questions and slow me down.

The goals are:

- To introduce you to Amateur Radio
- Prepare you to take (and pass) the technician and general exams

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General Class
Amateur Radio
& Satellite Stuff

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Welcome, over the next several sessions we will cover a substantial amount of information. please ask questions and slow me down.

The goals are:

- To introduce you to Amateur Radio
- Prepare you to take (and pass) the technician and general exams
- Introduce you to satellite communications.

A little about myself

Technician and
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Anthony
Odenthal,
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- Passed Tech Sept 2007
- Passed Gen Oct 2007
- Joined Benton County ARES April 2012
- Passed Extra April 2012
- Became a VE in June 2012

What is Amateur Radio?

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Amateur radio are people and activities that are regulated and encouraged, in the US and abroad, that allow licensed individuals to play around with radio waves, electronics, software, techniques, practices, and equipment to do all sorts of really cool stuff. Radio Amateurs are some of the least restricted users of radio spectrum, and with that freedom they have proven time and time again their worth. The term Amateur refers to someone who does something as a pastime rather than a profession.

Some useful tools

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Some things you may want to look into as useful for studying

- AA9PW practice exams <http://aa9pw.com>
- ARRL license Manuals [http://www.arrl.org/shop/
Licensing-Education-and-Training/](http://www.arrl.org/shop/Licensing-Education-and-Training/)

About the test

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Amateur Radio
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- 35 questions

About the test

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Amateur Radio
& Satellite Stuff

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Amateur Extra

- 35 questions
- Multiple Choice

About the test

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General Class
Amateur Radio
& Satellite Stuff

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- 35 questions
- Multiple Choice
- No time limit

About the test

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Amateur Radio
& Satellite Stuff

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- 35 questions
- Multiple Choice
- No time limit
- 396 questions in the tech pool, 457 in the general

About the test

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General Class
Amateur Radio
& Satellite Stuff

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- 35 questions
- Multiple Choice
- No time limit
- 396 questions in the tech pool, 457 in the general
- Need a 75% to pass

Shal we begin?

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General Class
Amateur Radio
& Satellite Stuff

Anthony
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KE7OSN
Amateur Extra

Remember if I go too fast or you have questions, let me know.

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

1 Who's In Charge

2 Part 97

3 licenses

4 Callsigns

5 frequencies

6 T1 Questions

- T1A
- T1B
- T1C
- T1D
- T1E
- T1F

Who's In charge

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

International Telecommunications Union (ITU)

- Worldwide, treaty-based organization that allocates frequencies for specific uses.
- Primary Users - first "rights" to a frequency
- Secondary Users - permitted to use a frequency but must not interfere with a primary user
- World divided into 3 regions, US is in Region 2
- Creates "bands" - sections of spectrum allocated for amateur radio use.

Who's In Charge

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Federal Communications Commission (FCC)

- Promulgates rules for non-federal radio users within ITU spec
- Divides amateur bands into mode-specific sub-bands
- Rules for telecommunications are in the Code of Federal Regulations, Chapter 47
- Rules for amateur radio are in Part 97 of Chapter 47 (47 CFR 97)

Who's In Charge

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

freqencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Frequency Coordinator

- FCC recognized regional groups that coordinate the use of bands between large number of users

Who's In Charge

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Frequency Coordinator

- FCC recognized regional groups that coordinate the use of bands between large number of users
- Appointed by amateurs for amateurs

Who's In Charge

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Frequency Coordinator

- FCC recognized regional groups that coordinate the use of bands between large number of users
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- Intended to help reduce and allow resolution of interference issues

Who's In Charge

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Frequency Coordinator

- FCC recognized regional groups that coordinate the use of bands between large number of users
- Appointed by amateurs for amateurs
- Intended to help reduce and allow resolution of interference issues
- Voluntary rules unless there is interference, then the coordinated user "wins"

Who's In Charge

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Frequency Coordinator

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- Intended to help reduce and allow resolution of interference issues
- Voluntary rules unless there is interference, then the coordinated user "wins"
- Gentleman's agreement

FCC allocations

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Amateur Radio
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**UNITED
STATES
FREQUENCY
ALLOCATIONS
THE RADIO SPECTRUM**

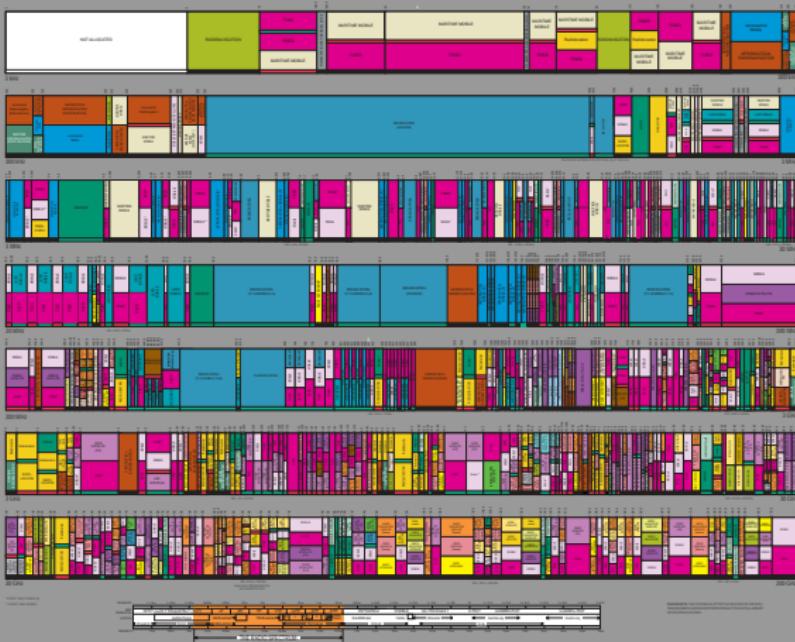


Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

1 Who's In Charge

2 Part 97

3 licenses

4 Callsigns

5 frequencies

6 T1 Questions

- T1A
- T1B
- T1C
- T1D
- T1E
- T1F

47 CRF 97.1 Basic Purpose

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles:

- A Recognition and enhancement of the value of the amateur service to the public as a *voluntary noncommercial communication service*, particularly with respect to providing emergency communications.

47 CRF 97.1 Basic Purpose

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles:

- A Recognition and enhancement of the value of the amateur service to the public as a *voluntary noncommercial communication service*, particularly with respect to providing emergency communications.
- B Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.

47 CRF 97.1 Basic Purpose

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles:

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- C Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.

47 CRF 97.1 Basic Purpose

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles:

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- C Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.
- D Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.

47 CRF 97.1 Basic Purpose

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles:

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- B Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.
- C Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.
- D Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.
- E Continuation and extension of the amateur's unique ability to enhance international goodwill.

Keyphrase

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General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

*...a voluntary noncommercial
communications service...*

This phrase sums up almost every rule and tenant of amateur radio.

A voluntary noncommercial communications service

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Noncommercial means no "pecuniary interest". It is illegal to profit from the use of amateur radio.

As with almost any rule there are exceptions"

- Teachers may use ham radio in the classroom as a teaching aid
- "Code practice" transmissions
- Disaster Drills

More basic rules

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General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- No Music - expect transmission or re-transmission of a signal from a space station
- No Broadcasting
- No commercial traffic
- No profanity
- No codes or ciphers intended to hid content
- No international third party traffic unless treaty-approved

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

1 Who's In Charge

2 Part 97

3 licenses

4 Callsigns

5 frequencies

6 T1 Questions

- T1A
- T1B
- T1C
- T1D
- T1E
- T1F

Licenses

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

A license is valid for ten years, with a two year grace period.
Upgrades don't count as renewals. Basic renewals are free!
There are five classes.

- *Novice
- Technician
- General
- *Advanced
- Extra

Licenses

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

There are four kinds of licenses, Individual hams hold both a "Station" and "Operator"

- Station
- Operator
- Club - W7OSU, K7CVO, W1AW
- Special Event - A7W

Clubs can get a "club callsign", and events can get an event callsign.

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

1 Who's In Charge

2 Part 97

3 licenses

4 Callsigns

5 frequencies

6 T1 Questions

- T1A
- T1B
- T1C
- T1D
- T1E
- T1F

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- US callsigns start with A,K,N, or W
- The format is one or two letters, a number, and one to three letters.
- New callsigns are assigned in sequential order - number indicates the region in the US
- Shorter callsigns are reserved for higher license classes
- 1X1 for special events only

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
- K7HZ

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
- K7HZ -That's an Extra

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
- K7HZ -That's an Extra
- VE6GLW

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
- K7HZ -That's an Extra
- VE6GLW -That's Canadian

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
- K7HZ -That's an Extra
- VE6GLW -That's Canadian
- KLOO

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
- K7HZ -That's an Extra
- VE6GLW -That's Canadian
- KLOO -That's a commercial station

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
- K7HZ -That's an Extra
- VE6GLW -That's Canadian
- KLOO -That's a commercial station
- WSJ509

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
- K7HZ -That's an Extra
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- KLOO -That's a commercial station
- WSJ509 -Land Mobile, Benton County Sheriff

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
- K7HZ -That's an Extra
- VE6GLW -That's Canadian
- KLOO -That's a commercial station
- WSJ509 -Land Mobile, Benton County Sheriff
- Mission Base

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
- K7HZ -That's an Extra
- VE6GLW -That's Canadian
- KLOO -That's a commercial station
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- Mission Base -What is known as a "tactical callsign"

Callsigns

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- KE7OSN
- N8GFO -Yep
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Operator

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Who "operates" an amateur station?

Operator

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Who "operates" an amateur station?

The control operator, who is designated by the station licensee, and determines the privileges of operation.

e.g. if you are at a radio that can operate outside your privileges, you still can only use what you are licensed to.

Your Callsign

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

A station must transmit it's callsign at least every ten minutes and at the end of every communication.

Special situations have special rules

- Control operator working outside of a station licensee privileges.
- Special event station control operator
- Control operator using new privileges prior to FCC database update

The Uniform Licensing System

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

The ULS is an online database of FCC license information. A new licensee may use their privileges as soon as their information appears in the ULS. When you upgrade you may use your new privileges as soon as you pass the test.

Typical uses of a callsign

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- W7OSU This is KE7OSN

Typical uses of a callsign

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- W7OSU This is KE7OSN
- Net Control This is KE7OSN

Typical uses of a callsign

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- W7OSU This is KE7OSN
- Net Control This is KE7OSN
- This is W7OSU (Go Ahead)

Typical uses of a callsign

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- W7OSU This is KE7OSN
- Net Control This is KE7OSN
- This is W7OSU (Go Ahead)
- CQ CQ CQ this is KE7OSN

Typical uses of a callsign

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- W7OSU This is KE7OSN
- Net Control This is KE7OSN
- This is W7OSU (Go Ahead)
- CQ CQ CQ this is KE7OSN
- KE7OSN monitoring

Typical uses of a callsign

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- W7OSU This is KE7OSN
- Net Control This is KE7OSN
- This is W7OSU (Go Ahead)
- CQ CQ CQ this is KE7OSN
- KE7OSN monitoring
- This is KF7FGE stroke (/) KE7OSN

Typical uses of a callsign

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- W7OSU This is KE7OSN
- Net Control This is KE7OSN
- This is W7OSU (Go Ahead)
- CQ CQ CQ this is KE7OSN
- KE7OSN monitoring
- This is KF7FGE stroke (/) KE7OSN
- Hey Bob, you around?

Hey bob, you around

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Hey bob you around?
Legal?

Hey bob, you around

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Hey bob you around?

Legal?

Yes, as long as you keep to the every ten minutes and the end of
every communication.

Hey bob, you around

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Hey bob you around?

Legal?

Yes, as long as you keep to the every ten minutes and the end of
every communication.

What if Bob isn't there?

Hey bob, you around

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

Hey bob you around?

Legal?

Yes, as long as you keep to the every ten minutes and the end of every communication.

What if Bob isn't there?

KE7OSN clear

Types of stations

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- Club – at least four people, one of which accepts responsibility and is the “trustee”.
- Space – at least 50km above the surface.
- Beacon – transmits a low-level signal for propagation studies
- Repeater – retransmits a signal heard on one frequency on another frequency.
- Auxillary – a secondary receiver that feeds a repeater station.

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

1 Who's In Charge

2 Part 97

3 licenses

4 Callsigns

5 frequencies

6 T1 Questions

- T1A
- T1B
- T1C
- T1D
- T1E
- T1F

Band Plan

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

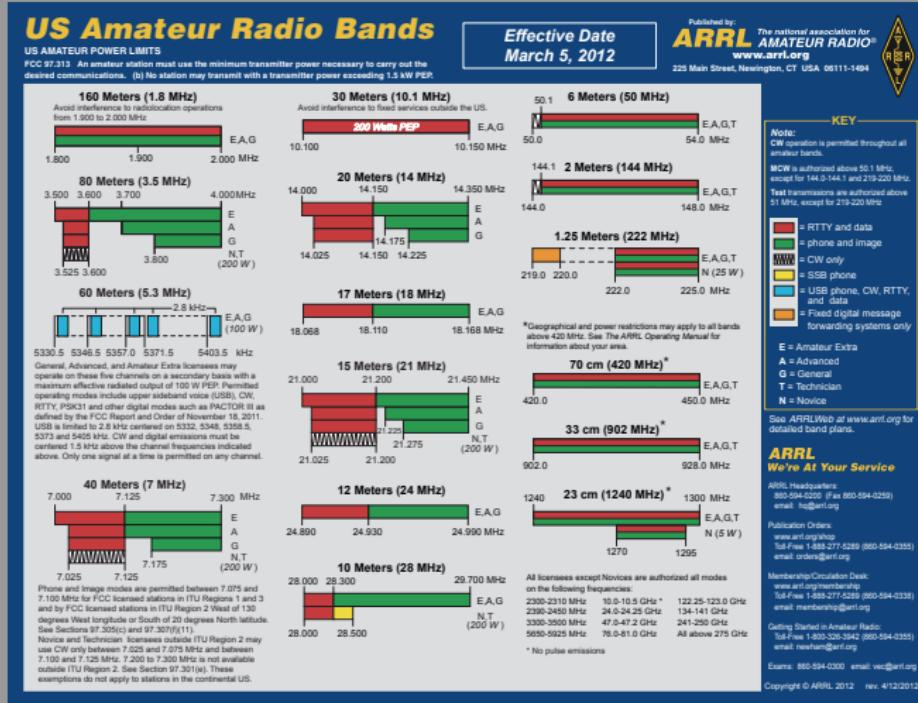
T1B

T1C

T1D

T1E

T1F



ITU Band Names

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- MF - Medium Frequency 300KHz to 3MHz
- HF - High Frequency 3MHz to 30 MHz
- VHF - Very High Frequency 30MHz to 300MHz
- UHF - Ultra High Frequency 300MHz to 3GHz
- SHF - Super High Frequency 3GHz to 30GHz
- EHF - Extremely High Frequency - 30GHz to 300GHz
- THF - Tremendously High Frequency - 300GHZ to 3THz

HF 3-30MHz

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- 80 Meters

- 3.525-3.600MHz: CW Only

- 40 Meters

- 7.025-7.125MHz: CW Only

- 15 Meters

- 21.025-21.200MHz: CW Only

- 10 Meters

- 28.000-28.300MHz: CW, RTTY/Data 200 watts PEP max
 - 28.300-28.500MHz: CW, Phone 200 watts PEP max

VHF 30-300MHz

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- 6 Meters

- 50.0-50.1MHz CW Only
- 50.1-54.0MHz All modes

- 2 Meters

- 144.0-144.1MHz CW Only
- 144.1-148.0MHz All modes

- 1.25 Meters

- 222.00-225.00MHz All modes

UHF 300-3000MHz (3GHz)

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- 70 Centimeters
 - 420.0-450.0MHz All Modes
- 33 Centimeters
 - 902.0-928.0MHz All Modes
- 23 Centimeters
 - 1240-1300MHz All Modes
- 2.4GHz
 - 2.3-2.31GHz
 - 2.39-2.45GHz *

2.4GHz

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

We share the 2390-2450MHz band with: 802.11 networks, cordless phones, video cameras, zigbee, etc.

We are PRIMARY users. We have first "rights". Secondary users must not cause us interference and must accept interference from our operations.

SHF 3GHz-30GHz and up

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- 3.3-3.5GHz
- 5.65-5.925GHz
- 10.0-10.5GHz
- 24.0-24.25GHz
- 47.0-47.2GHz
- 76.0-81.9GHz
- 119.98-120.02GHz
- 142-149GHz
- 241-250GHz
- Everything above 300GHz

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

1 Who's In Charge

2 Part 97

3 licenses

4 Callsigns

5 frequencies

6 T1 Questions

- T1A
- T1B
- T1C
- T1D
- T1E
- T1F

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**

- D. Persons who are interested in radio technique solely with a personal aim and without pecuniary interest

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**
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?**
C. The FCC

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**
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?**
C. The FCC
- **T1A03 Which part of the FCC rules contains the rules and regulations governing the Amateur Radio Service?**
D. Part 97

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**
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?**
C. The FCC
- **T1A03 Which part of the FCC rules contains the rules and regulations governing the Amateur Radio Service?**
D. Part 97
- **T1A04 Which of the following meets the FCC definition of harmful interference?**
C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**
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?**
C. The FCC
- **T1A03 Which part of the FCC rules contains the rules and regulations governing the Amateur Radio Service?**
D. Part 97
- **T1A04 Which of the following meets the FCC definition of harmful interference?**
C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations
- **T1A05 What is the FCC Part 97 definition of a space station?**
D. An amateur station located more than 50 km above the Earth's surface

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**
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?**
C. The FCC
- **T1A03 Which part of the FCC rules contains the rules and regulations governing the Amateur Radio Service?**
D. Part 97
- **T1A04 Which of the following meets the FCC definition of harmful interference?**
C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations
- **T1A05 What is the FCC Part 97 definition of a space station?**
D. An amateur station located more than 50 km above the Earth's surface
- **T1A06 What is the FCC Part 97 definition of telecommand?**
C. A one-way transmission to initiate, modify or terminate functions of a device at a distance

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**
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?**
C. The FCC
- **T1A03 Which part of the FCC rules contains the rules and regulations governing the Amateur Radio Service?**
D. Part 97
- **T1A04 Which of the following meets the FCC definition of harmful interference?**
C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations
- **T1A05 What is the FCC Part 97 definition of a space station?**
D. An amateur station located more than 50 km above the Earth's surface
- **T1A06 What is the FCC Part 97 definition of telecommand?**
C. A one-way transmission to initiate, modify or terminate functions of a device at a distance
- **T1A07 What is the FCC Part 97 definition of telemetry?**
C. A one-way transmission of measurements at a distance from the measuring instrument

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**
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?**
C. The FCC
- **T1A03 Which part of the FCC rules contains the rules and regulations governing the Amateur Radio Service?**
D. Part 97
- **T1A04 Which of the following meets the FCC definition of harmful interference?**
C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations
- **T1A05 What is the FCC Part 97 definition of a space station?**
D. An amateur station located more than 50 km above the Earth's surface
- **T1A06 What is the FCC Part 97 definition of telecommand?**
C. A one-way transmission to initiate, modify or terminate functions of a device at a distance
- **T1A07 What is the FCC Part 97 definition of telemetry?**
C. A one-way transmission of measurements at a distance from the measuring instrument
- **T1A08 Which of the following entities recommends transmit/receive channels and other parameters for auxiliary and repeater stations?**
B. Frequency Coordinator

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**
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?**
C. The FCC
- **T1A03 Which part of the FCC rules contains the rules and regulations governing the Amateur Radio Service?**
D. Part 97
- **T1A04 Which of the following meets the FCC definition of harmful interference?**
C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations
- **T1A05 What is the FCC Part 97 definition of a space station?**
D. An amateur station located more than 50 km above the Earth's surface
- **T1A06 What is the FCC Part 97 definition of telecommand?**
C. A one-way transmission to initiate, modify or terminate functions of a device at a distance
- **T1A07 What is the FCC Part 97 definition of telemetry?**
C. A one-way transmission of measurements at a distance from the measuring instrument
- **T1A08 Which of the following entities recommends transmit/receive channels and other parameters for auxiliary and repeater stations?**
B. Frequency Coordinator
- **T1A09 Who selects a Frequency Coordinator?**
C. Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**
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?**
C. The FCC
- **T1A03 Which part of the FCC rules contains the rules and regulations governing the Amateur Radio Service?**
D. Part 97
- **T1A04 Which of the following meets the FCC definition of harmful interference?**
C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations
- **T1A05 What is the FCC Part 97 definition of a space station?**
D. An amateur station located more than 50 km above the Earth's surface
- **T1A06 What is the FCC Part 97 definition of telecommand?**
C. A one-way transmission to initiate, modify or terminate functions of a device at a distance
- **T1A07 What is the FCC Part 97 definition of telemetry?**
C. A one-way transmission of measurements at a distance from the measuring instrument
- **T1A08 Which of the following entities recommends transmit/receive channels and other parameters for auxiliary and repeater stations?**
B. Frequency Coordinator
- **T1A09 Who selects a Frequency Coordinator?**
C. Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations
- **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

T1A 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1A01 For whom is the Amateur Radio Service intended?**
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?**
C. The FCC
- **T1A03 Which part of the FCC rules contains the rules and regulations governing the Amateur Radio Service?**
D. Part 97
- **T1A04 Which of the following meets the FCC definition of harmful interference?**
C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations
- **T1A05 What is the FCC Part 97 definition of a space station?**
D. An amateur station located more than 50 km above the Earth's surface
- **T1A06 What is the FCC Part 97 definition of telecommand?**
C. A one-way transmission to initiate, modify or terminate functions of a device at a distance
- **T1A07 What is the FCC Part 97 definition of telemetry?**
C. A one-way transmission of measurements at a distance from the measuring instrument
- **T1A08 Which of the following entities recommends transmit/receive channels and other parameters for auxiliary and repeater stations?**
B. Frequency Coordinator
- **T1A09 Who selects a Frequency Coordinator?**
C. Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations
- **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
- **T1A11 Which of the following stations transmits signals over the air from a remotereceive site to a repeater for retransmission?**
C. Auxiliary station

T1B 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F



T1B01 What is the ITU?

B. A United Nations agency for information and communication technology issues

T1B 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1B01 What is the ITU?**
B. A United Nations agency for information and communication technology issues
- **T1B02 North American amateur stations are located in which ITU region?**
B. Region 2

T1B 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1B01 What is the ITU?**
B. A United Nations agency for information and communication technology issues
- **T1B02 North American amateur stations are located in which ITU region?**
B. Region 2
- **T1B03 Which frequency is within the 6 meter band?**
B. 52.525 MHz

T1B 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1B01 What is the ITU?**
B. A United Nations agency for information and communication technology issues
- **T1B02 North American amateur stations are located in which ITU region?**
B. Region 2
- **T1B03 Which frequency is within the 6 meter band?**
B. 52.525 MHz
- **T1B04 Which amateur band are you using when your station is transmitting on 146.52MHz?**
A. 2 meter band

T1B 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1B01 What is the ITU?**
B. A United Nations agency for information and communication technology issues
- **T1B02 North American amateur stations are located in which ITU region?**
B. Region 2
- **T1B03 Which frequency is within the 6 meter band?**
B. 52.525 MHz
- **T1B04 Which amateur band are you using when your station is transmitting on 146.52MHz?**
A. 2 meter band
- **T1B05 Which 70 cm frequency is authorized to a Technician Class license holder operating in ITU Region 2?**
C. 443.350 MHz

T1B 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1B01 What is the ITU?**
B. A United Nations agency for information and communication technology issues
- **T1B02 North American amateur stations are located in which ITU region?**
B. Region 2
- **T1B03 Which frequency is within the 6 meter band?**
B. 52.525 MHz
- **T1B04 Which amateur band are you using when your station is transmitting on 146.52MHz?**
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C. 443.350 MHz
- **T1B06 Which 23 cm frequency is authorized to a Technician Class operator license?**
B. 1296 MHz

T1B 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1B01 What is the ITU?**
B. A United Nations agency for information and communication technology issues
- **T1B02 North American amateur stations are located in which ITU region?**
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- **T1B03 Which frequency is within the 6 meter band?**
B. 52.525 MHz
- **T1B04 Which amateur band are you using when your station is transmitting on 146.52MHz?**
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T1B 6 Questions from T1

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General Class
Amateur Radio
& Satellite Stuff

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Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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- **T1B08 What do the FCC rules mean when an amateur frequency band is said to be available on a secondary basis?**
C. Amateurs may not cause harmful interference to primary users

T1B 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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B. A United Nations agency for information and communication technology issues
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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

T1B 6 Questions from T1

Technician and
General Class
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Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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B. A United Nations agency for information and communication technology issues
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- **T1B10 Which of the bands available to Technician Class operators have mode-restricted sub-bands?**
C. The 6 meter, 2 meter, and 1.25 meter bands

T1B 6 Questions from T1

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General Class
Amateur Radio
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Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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B. A United Nations agency for information and communication technology issues
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- **T1B10 Which of the bands available to Technician Class operators have mode-restricted sub-bands?**
C. The 6 meter, 2 meter, and 1.25 meter 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

T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
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Part 97

licenses

Callsigns

freqencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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C. Special event

T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

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Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
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Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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C. Special event
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T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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B. Revocation of the station license or suspension of the operator license
- **T1C08** What is the normal term for an FCC-issued primary station/operator license grant?
C. Ten years

T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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C. Ten years
- **T1C09** What is the grace period following the expiration of an amateur license within which the license may be renewed?
A. Two years

T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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- **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?
C. As soon as your name and call sign appear in the FCC's ULS database

T1C 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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C. 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, may you continue to operate a transmitter on amateur service frequencies?
A. No, transmitting is not allowed until the ULS database shows that the license has been renewed

T1D 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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A. Any country whose administration has notified the ITU that it objects to such communications

T1D 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Who's In Charge

Part 97

licenses

Callsigns

Frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1D 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

freqencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1D 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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C. Only when transmitting control commands to space stations or radio control craft
- **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

T1D 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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A. When incidental to an authorized retransmission of manned spacecraft communications
- **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

T1D 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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- **T1D06 Which of the following types of transmissions are prohibited?**
A. Transmissions that contain obscene or indecent words or language

T1D 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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A. Transmissions that contain obscene or indecent words or language
- **T1D08 When may the control operator of an amateur station receive compensation for operating the station?**
B. When the communication is incidental to classroom instruction at an educational institution

T1D 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **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
- **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
- **T1D03 When is the transmission of codes or ciphers allowed to hide the meaning of a message transmitted by an amateur station?**
C. Only when transmitting control commands to space stations or radio control craft
- **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
- **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
- **T1D06 Which of the following types of transmissions are prohibited?**
A. Transmissions that contain obscene or indecent words or language
- **T1D08 When may the control operator of an amateur station receive compensation for operating the station?**
B. When the communication is incidental to classroom instruction at an educational institution
- **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

T1D 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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

T1D 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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- **T1D11 Which of the following types of communications are permitted in the Amateur Radio Service?**
A. Brief transmissions to make station adjustments

T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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A. Only when the station is transmitting

T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

freqencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

freqencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

freqencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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B. Remote

T1E 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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D. The station licensee

T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1F01 What type of identification is being used when identifying a station on the air as Race Headquarters ?**
A. Tactical call

T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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C. The English language

T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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

T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
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Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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A. Never
- **T1F09** What type of amateur station simultaneously retransmits the signal of another amateur station on a different channel or channels?
C. Repeater station

T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

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KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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- **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
- **T1F09 What type of amateur station simultaneously retransmits the signal of another amateur station on a different channel or channels?**
C. Repeater station
- **T1F10 Who is accountable should a repeater inadvertently retransmit communications that violate the FCC rules?**
A. The control operator of the originating station

T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

- **T1F01 What type of identification is being used when identifying a station on the air as Race Headquarters ?**
 - A. Tactical call
- **T1F02 When using tactical identifiers, how often must your station transmit the stations FCC-assigned call sign?**
 - C. Every ten minutes
- **T1F03 When is an amateur station required to transmit its assigned call sign?**
 - D. At least every 10 minutes during and at the end of a contact
- **T1F04 Which of the following is an acceptable language for use for station identification when operating in a phone sub-band?**
 - C. The English language
- **T1F05 What method of call sign identification is required for a station transmitting phone signals?**
 - B. Send the call sign using CW or 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
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 - A. The control operator of the originating station
- **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

T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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 - B. At least 4

T1F 6 Questions from T1

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Who's In Charge

Part 97

licenses

Callsigns

frequencies

T1 Questions

T1A

T1B

T1C

T1D

T1E

T1F

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 - B. At least 4
- T1F13 When must the station licensee make the station and its records available for FCC inspection?**
 - B. Any time upon request by an FCC representative

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

7 Emergency Operations

8 Nets and messages

9 Radio Speak

10 Other Practices

11 T2 Questions

- T2A
- T2B
- T2C

97.403 Safety of life and protection of property

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

No provision of these rules prevents the use by an amateur station of any means of radio communication at its disposal to provide essential communication needs in connection with the immediate safety of human life and immediate protection of property when normal communication systems are not available.

97.403 Safety of life and protection of property

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

No provision of these rules prevents the use by an amateur station of any means of radio communication at its disposal to provide essential communication needs in connection with the immediate safety of human life and immediate protection of property **when normal communication systems are not available.**

ARES

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

ARES – Amateur Radio Emergency Service

- Organized and run by ARRL
- Supports governmental and NGO groups.
- Most groups are organized at the county level
- “EC” – Emergency Coordinator

RACES

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

RACES – Radio Amateur Civil Emergency Service

- Defined by the FCC
- Supports governmental agencies ONLY.
- Operators are registered with the controlling agency.
- RACES Officer
- Activated by federal declaration of emergency.
- In Oregon, ARES members are also registered in RACES

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

7 Emergency Operations

8 Nets and messages

9 Radio Speak

10 Other Practices

11 T2 Questions

- T2A
- T2B
- T2C

Disaster == Organized Chaos

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

To keep some organization to the use of frequencies and communications, groups are organized into “nets”. A “net” is a group of stations that are cooperating in the use of a frequency. The “net control” is responsible for deciding who gets to talk.

Disaster == Organized Chaos

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

There are two kinds of nets:

Directed - the net control is strict in controlling who talks to whom. Stations tell net control they have a message for another station, and the net control directs them to call that station and pass the message.

Free - the net control allows stations to contact each other as they need to.

Disaster == Organized Chaos

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

There are three types of messages

Formal - written messages.

Informal - unwritten messages.

Administrative - station to station housekeeping.

Written Messages – Formal Traffic

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

ARES and RACES have adopted the NIMS/ICS system for written traffic. I.e., ICS-213 message forms, in either digital or transcribed versions.

Written Messages – Formal Traffic

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

ARES and RACES have adopted the NIMS/ICS system for written traffic. I.e., ICS-213 message forms, in either digital or transcribed versions.

The TEST doesn't ask you about that. The TEST deals with the National Traffic System message form.

Written Messages – Formal Traffic

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

The National Traffic System (NTS) is a system organized by ARRL to transmit messages in a standard format, usually concerning “Health and Welfare”. For example: “Aunt Martha arrived home safely. Have a happy birthday.” Or “welcome to Ham radio”. These messages use the NTS RadioGram form. The process is described in depth in the Message Processing Guidelines (MPG).

NTS RadioGram Form

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C



The American Radio Relay League
RADIOGRAM
Via Amateur Radio

Number	Precedence	HX	Station of Origin	Check	Place of Origin	Time Filed	Date

To:

This Radio Message was received at:

Amateur Station _____ Date _____
Name _____
Street Address _____
City, State, Zip _____

Telephone Number:

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

From	Date	Time	To	Date	Time
REC'D			SENT		

A licensed Amateur Radio Operator, whose address is shown above, handled this message free of charge. As such messages are handled solely for the pleasure of operating, a "Ham" Operator can accept no compensation. A return message may be filed with the "Ham" delivering this message to you. Further information on Amateur Radio may be obtained from ARRL Headquarters, 225, Main Street, Newington, CT 06111.

The American Radio Relay League, Inc. is the National Membership Society of licensed radio amateurs and the publisher of QST Magazine. One of its functions is promotion of public service communication among Amateur Operators. To that end, the League has organized the National Traffic System for daily nationwide message handling.

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

7 Emergency Operations

8 Nets and messages

9 Radio Speak

10 Other Practices

11 T2 Questions

- T2A
- T2B
- T2C

Types of radio short-hand

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

Amateur radio has its own codes, and slang. Much like 1337 or txt, this "shared language" makes it easier to communicate quickly, and efficiently. Much of it comes from the days of telegraph and Morse Code.

Q Codes - Three letter codes beginning with Q

Number codes - Codes sent as numbers, we really only us 73

Pro-words - Standardized ways of saying things in a clear and concise fashion

Phonetics - Words for letters, try saying BCDEZGT five times fast.

Q-Codes

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

Q codes are three letter codes that begin with Q and not QU and can be sent as either a question or a response. Really useful when using Morse Code as the codes are much shorter than what they represent. Some common Q codes are listed below.

QSY Change frequency

QRT Stop transmitting

QRZ I'm calling

QRM Man made interference

QRN Natural interference or Noise

QLS Acknowledge

QST Message to all amateurs

Q-Codes

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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Pro-words

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

Pro or Professional words are used as shorthand, and because they prevent confusion. Yea and Nah kinda sound the same.

Roger Received

WilCO Will Comply

Over I'm done talking for now

Out I'm done talking to you

This Is I'm going to say my callsign now

Wait Hold on for a while

Affirmative Yes

Negative No

Phonetics

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

In amateur radio we use ITU phonetics, this helps us reduce the potential of confusion over letters that sound the same

A - Alfa "AL-FAH"	N - November "NO-VEM-BER"	0 "ZEE-RO"
B - Bravo "BRAH-VOH"	O - Oscar "OSS-CAH"	1 "WUN"
C - Charlie "CHAR-LEE"	P - Papa "PAH-PAH"	2 "TOO"
D - Delta "DELL-TAH"	Q - Quebec "KEH-BECK"	3 "TH-UH-REE"
E - Echo "ECK-OH"	R - Romeo "ROW-ME-OH"	4 "FOW-ER"
F - Foxtrot "FOKS-TROT"	S - Sierra "SEE-AIR-RAH"	5 "FI-IV" OR "FIFE"
G - Golf "GOLF"	T - Tango "TANG-GO"	6 "SIX"
H - Hotel "HOH-TELL"	U - Uniform "YOU-NEE-FORM"	7 "SEV-EN"
I - India "IN-DEE-AH"	V - Victor "VIK-TAH"	8 "ATE"
J - Juliett "JEW-LEE-ETT"	W - Whiskey "WISS-KEY"	9 "NIN-ER"
K - Kilo "KEE-LOH"	X - X-Ray "ECKS-RAY"	
L - Lima "LEE-MAH"	Y - Yankee "YANG-KEY"	
M - Mike "MIKE"	Z - Zulu "ZOO-LOO"	

W7QH becomes "Whiskey 7 Quebec Hotel"

CQ and 73

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

There are two other special cases.

- CQ is the standard calling call. Think of it as Seek You, though no one really knows where it comes from. It is common to add extra stuff depending on the situation. You might hear CQ JOTA, CQ Field Day, CQ Contest, CQ DX, CQ Oregon. This lets people pick who they are looking for. A common general CQ would sound like "CQ CQ CQ this is KE7OSN calling CQ CQ CQ"
- The other thing that comes up is the number 73, this goes back to the old Western Union Telegraph 92 codes, these were numbers that could be used in place of certain phrases, most of them dealing with packages or trains. 73 means "Beast Regards" and is generally used as "goodbye"

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

7 Emergency Operations

8 Nets and messages

9 Radio Speak

10 Other Practices

11 T2 Questions

- T2A
- T2B
- T2C

Power

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

In most amateur bands the maximum legal limit for power output is 1500 Watts, PEP. PEP - Peak Envelope Power is the largest amplitude of a signal. On some bands the limit is lower, for each band there is also a point at which you have to do a safety evaluation of your station to avoid unsafe exposure. You should always use the minimal power required to do what you need to do.

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

7 Emergency Operations

8 Nets and messages

9 Radio Speak

10 Other Practices

11 T2 Questions

- T2A
- T2B
- T2C

T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2A01 What is the most common repeater frequency offset in the 2 meter band?**
B. plus or minus 600 kHz

T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2A01 What is the most common repeater frequency offset in the 2 meter band?**
B. plus or minus 600 kHz
- **T2A02 What is the national calling frequency for FM simplex operations in the 70 cm band?**
D. 446.000 MHz

T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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B. Say the station's call sign then identify with your call sign

T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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

T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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C. The other station's call sign 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

T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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- **T2A06 What must an amateur operator do when making on-air transmissions to test equipment or antennas?**
A. Properly identify the transmitting station
- **T2A07 Which of the following is true when making a test transmission?**
D. Station identification is required at least every ten minutes during the test and at the end

T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2A01 What is the most common repeater frequency offset in the 2 meter band?**
B. plus or minus 600 kHz
- **T2A02 What is the national calling frequency for FM simplex operations in the 70 cm band?**
D. 446.000 MHz
- **T2A03 What is a common repeater frequency offset in the 70 cm band?**
A. Plus or minus 5 MHz
- **T2A04 What is an appropriate way to call another station on a repeater if you know the other station's call sign?**
B. Say the station's call sign then identify with your call sign
- **T2A05 What should you transmit when responding to a call of CQ?**
C. The other station's call sign 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
- **T2A07 Which of the following is true when making a test transmission?**
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"?**
D. Calling any station

T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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D. Calling any station
- T2A09 What brief statement is often used in place of "CQ" to indicate that you are listening on a repeater?**
B. Say your call sign

T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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A. A voluntary guideline for using different modes or activities within an amateur band

T2A 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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- **T2A11 What are the FCC rules regarding power levels used in the amateur bands?**
D. An amateur must use the minimum transmitter power necessary to carry out the desired communication

T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2B01 What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?**
- C. Simplex communication

T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- T2B01 What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?
C. Simplex 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?
D. CTCSS

T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- T2B01 What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?
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T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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C. The repeater receiver may require a DCS tone sequence for access
D. All of these choices are correct

T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- T2B01** What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?
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T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- T2B01** What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?
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D. Check your transmitter for off-frequency operation or spurious emissions

T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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B. Properly identify your transmission and move to a different frequency

T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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T2B 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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- T2B11** What is the "Q" signal used to indicate that you are changing frequency?
B. QSY

T2C 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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

T2C 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2C01 What set of rules applies to proper operation of your station when using amateur radio at the request of public service officials?**
C. FCC Rules
- **T2C04 What do RACES and ARES have in common?**
D. Both organizations may provide communications during emergencies

T2C 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2C01 What set of rules applies to proper operation of your station when using amateur radio at the request of public service officials?**
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T2C 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2C01 What set of rules applies to proper operation of your station when using amateur radio at the request of public service officials?**
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C. Begin your transmission with Priority or Emergency followed by your call sign

T2C 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2C01 What set of rules applies to proper operation of your station when using amateur radio at the request of public service officials?**
C. FCC Rules
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- **T2C07 What should you do to minimize disruptions to an emergency traffic net once you have checked in?**
C. Do not transmit on the net frequency until asked to do so by the net control station

T2C 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2C01 What set of rules applies to proper operation of your station when using amateur radio at the request of public service officials?**
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A. Passing messages exactly as written, spoken or as received

T2C 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2C01 What set of rules applies to proper operation of your station when using amateur radio at the request of public service officials?**
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B. When normal communications systems are not available

T2C 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

- **T2C01 What set of rules applies to proper operation of your station when using amateur radio at the request of public service officials?**
C. FCC Rules
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- **T2C10 What is the preamble in a formal traffic message?**
D. The information needed to track the message as it passes through the amateur radio traffic handling system

T2C 3 questions from T2

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Emergency
Operations

Nets and
messages

Radio Speak

Other Practices

T2 Questions

T2A

T2B

T2C

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- **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
- **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?**
B. When normal communications systems are not available
- **T2C10 What is the preamble in a formal traffic 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

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

12 Electromagnetic Waves

13 Propagation

14 T3 Questions

- T3A
- T3B
- T3C

Electromagnetic Waves

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

Electromagnetic waves are energy waves that move through space, similar to the way waves move in water or sound through air.

In a vacuum these waves move at the speed of light $299,792,458\text{m/s}$ or $186,282.397\text{ miles/second}$. This is good as these waves are light.

Speed of light

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

We can round up to $300,000,000\text{m/s}$. Some distance measured in terms of light-time

Average distance between the Sun and Earth - 8 minutes

GEO Satellite to Earth's Surface - about a half second

Nearest other star to our Sun 4.25 Years

Voyager Space probe to the Sun at 18,884,401,200 Km from the sun?

Speed of light

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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$$\text{sun? } \frac{18884401200\text{Km}}{300000\text{Km/s}} = \text{Hours}$$

Speed of light

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

We can round up to 300,000,000m/s. Some distance measured in terms of light-time

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Frequency - not just an ok movie

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

We often refer to a wave by it's frequency. Frequency is the number of times a wave cycles in a given time. We use Hertz (Hz) which has the unites of $\frac{1}{\text{Seconds}}$.

Middle C is 440Hz, or 440 cycles per second.

KLOO-AM is 1.340MHz, or 1,340,000 cycles per second.

SI Prefixs

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

Sometimes it is a lot easier to shorten things up a bit.

Tera T 10^{12} 1,000,000,000,000

Giga G 10^9 1,000,000,000

Mega M 10^6 1,000,000

Kilo K 10^3 1,000

Deci d 10^{-1} 0.1

Centi c 10^{-2} 0.01

Milli m 10^{-3} 0.001

Micro μ 10^{-6} 0.000001

Nano n 10^{-9} 0.000000001

Pico p 10^{-12} 0.000000000001

Wavelength

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

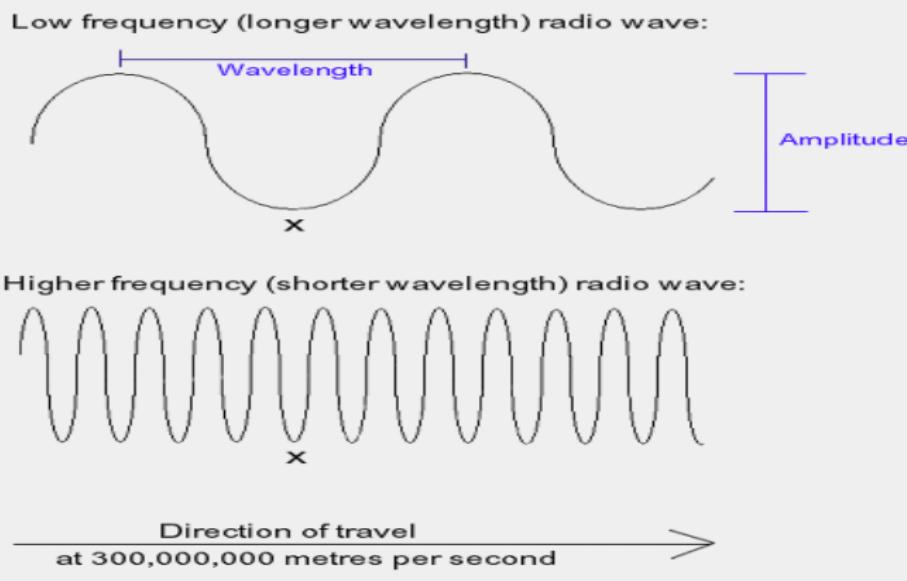
T3 Questions

T3A

T3B

T3C

We also use wavelength to describe waves. The wavelength is the distance between two like points on the wave exactly one cycle apart, e.g. the distance between peaks.



ElectoMagnetic

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

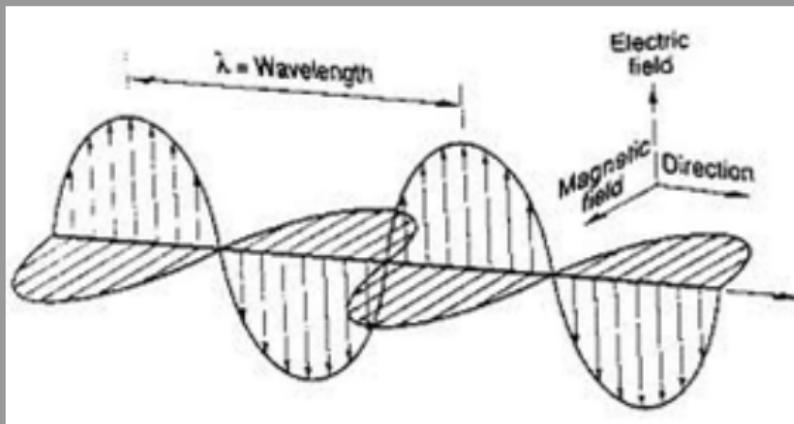
Propagation

T3 Questions

T3A

T3B

T3C



Electromagnetic waves have two parts, one electric part, and one magnetic part. The magnetic part is rotated and phase shifted by 90°

Wavelength to frequency and back

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

It is easy to convert between wavelength and frequency just use the equation below.

Wavelength to frequency and back

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

It is easy to convert between wavelength and frequency just use the equation below.

$$\text{Wavelength(meters)} = \frac{300}{\text{Freq.(MHz)}}$$

Wavelength to frequency and back

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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$$\text{Wavelength(meters)} = \frac{300}{\text{Freq.(MHz)}}$$

We'll practice on the next slide

MATH!!!

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

MATH!!!

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

$$\text{Wavelength}(\lambda) = \frac{300}{7.025}$$

MATH!!!

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

$$\text{Wavelength}(\lambda) = \frac{300}{7.025} \text{ that comes out to 42.7meters}$$

MATH!!!

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

$\text{Wavelength}(\lambda) = \frac{300}{7.025}$ that comes out to 42.7meters
That fits nicely in the 40meter band

MATH!!!

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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$\text{Wavelength}(\lambda) = \frac{300}{7.025}$ that comes out to 42.7meters
That fits nicely in the 40meter band

- Now lets try 223.50MHz

$$\frac{300}{223.50} = ?$$

MATH!!!

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

$\text{Wavelength}(\lambda) = \frac{300}{7.025}$ that comes out to 42.7meters
That fits nicely in the 40meter band

- Now lets try 223.50MHz
 $\frac{300}{223.50} = ?$ 1.35, for the 1.25meter band.

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

12 Electromagnetic Waves

13 Propagation

14 T3 Questions

- T3A
- T3B
- T3C

Line of sight

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

Just like light radio waves travel in a straight line.

Line of sight

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

Just like light radio waves travel in a straight line.
They also reflect off some things like light.

Line of sight

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

Just like light radio waves travel in a straight line.
They also reflect off some things like light.
If there are multiple ways for radio waves to get between two points
we call this Multipath, and it creates interference.

Line of sight

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

Just like light radio waves travel in a straight line.

They also reflect off some things like light.

If there are multiple ways for radio waves to get between two points we call this Multipath, and it creates interference.

Reflections can be really useful when you don't have a direct line of sight.

Line of sight

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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They also reflect off some things like light.

If there are multiple ways for radio waves to get between two points we call this Multipath, and it creates interference.

Reflections can be really useful when you don't have a direct line of sight.

Radio waves will also refract.

Solar Wind

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Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

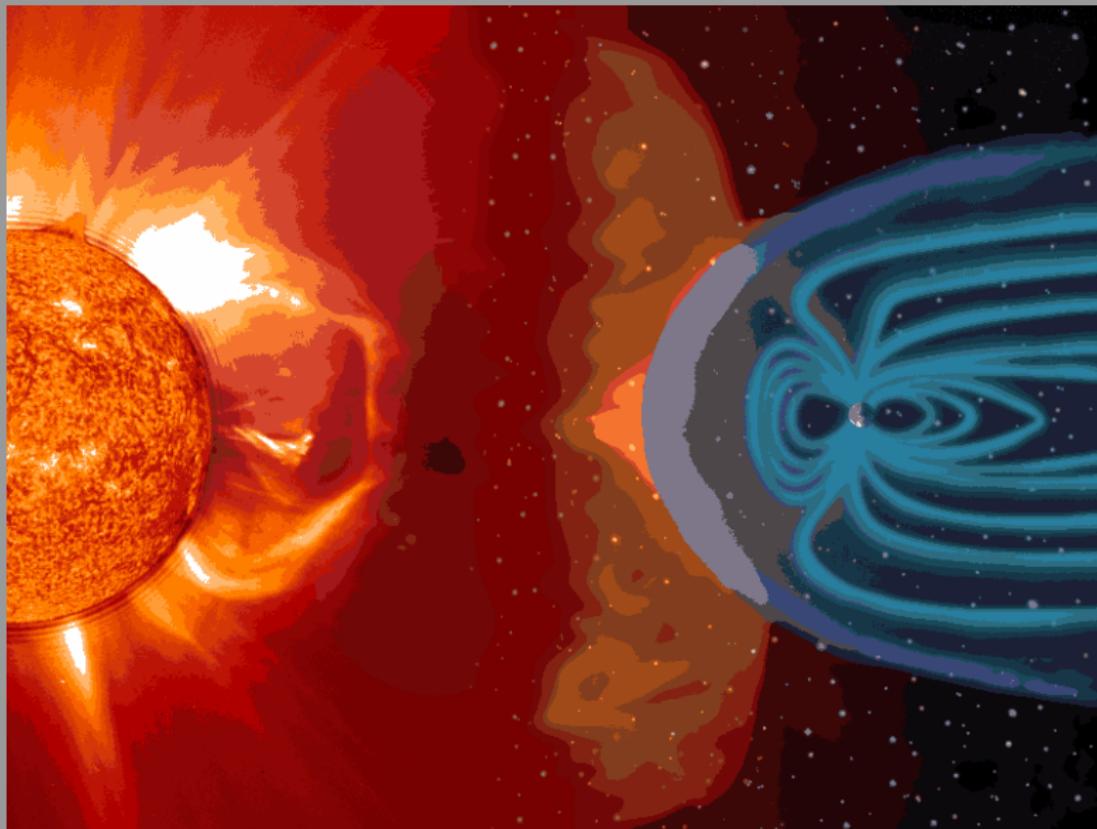
Propagation

T3 Questions

T3A

T3B

T3C



Solar Radiation

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

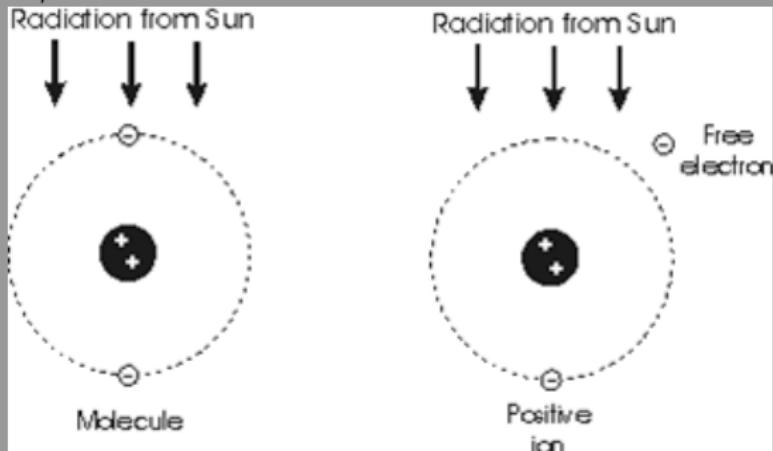
T3A

T3B

T3C

At night the electrons recombined with their atoms. This means things change from day to night.

Solar radiation charges atoms in the atmosphere, breaking loose electrons, to create ions, which can interact with radio waves.



Ionosphere

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General Class
Amateur Radio
& Satellite Stuff

Anthony
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KE7OSN
Amateur Extra

Electromagnetic
Waves

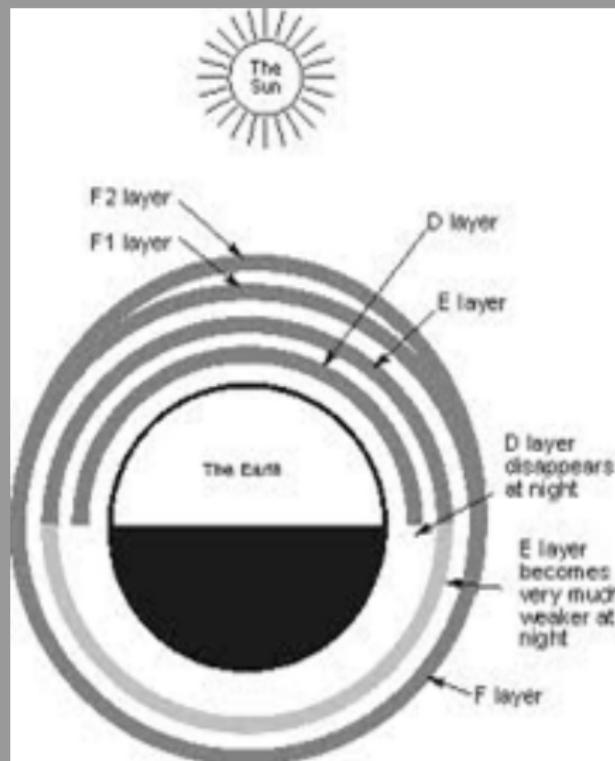
Propagation

T3 Questions

T3A

T3B

T3C



The parts of the atmosphere most affected by ionization are collectively called the Ionosphere! It has multiple layers, each interact differently with radio waves. The D layers mostly absorbs RF, while the E and F layers reflect. HF is ruled by the ionosphere. VHF and up . . . not so much.

Ionosphere

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

During the day the D layers absorbs a large chunk of HF, at night it goes away and signals bounce (refract) off the E and F layers.
VHF and above mostly just goes through the ionosphere...
But sometimes at night there is just enough E layer to refract VHF signals. We call this "Sporadic E"

Auroras and Meteor Showers

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

The auroras are a visible sign of ionization, as they move they can cause received signals to sound fluttery.

Meteor showers leave short lived trails of ionized gases, that can refract signals, these effects are impossible to predict and last seconds.

You can even bounce radio signals off the moon!

Tropospheric Ducting

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General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

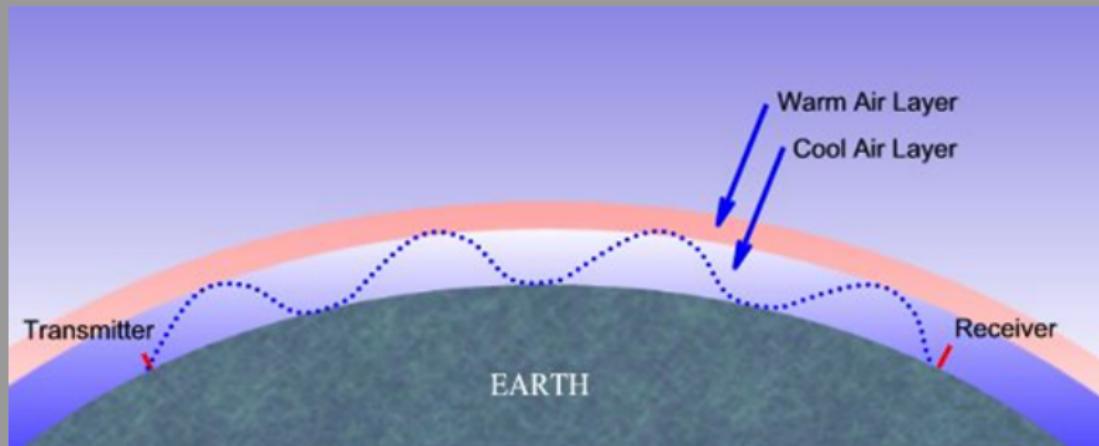
Propagation

T3 Questions

T3A

T3B

T3C



Air can refract electromagnetic radiation. A temperature inversion (warm air above cold) can cause VHF signals to refract and travel long distances.

This is called "Tropospheric Ducting" and often happens between here and Hawaii, it mostly affects VHF.

Knife Edge

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General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

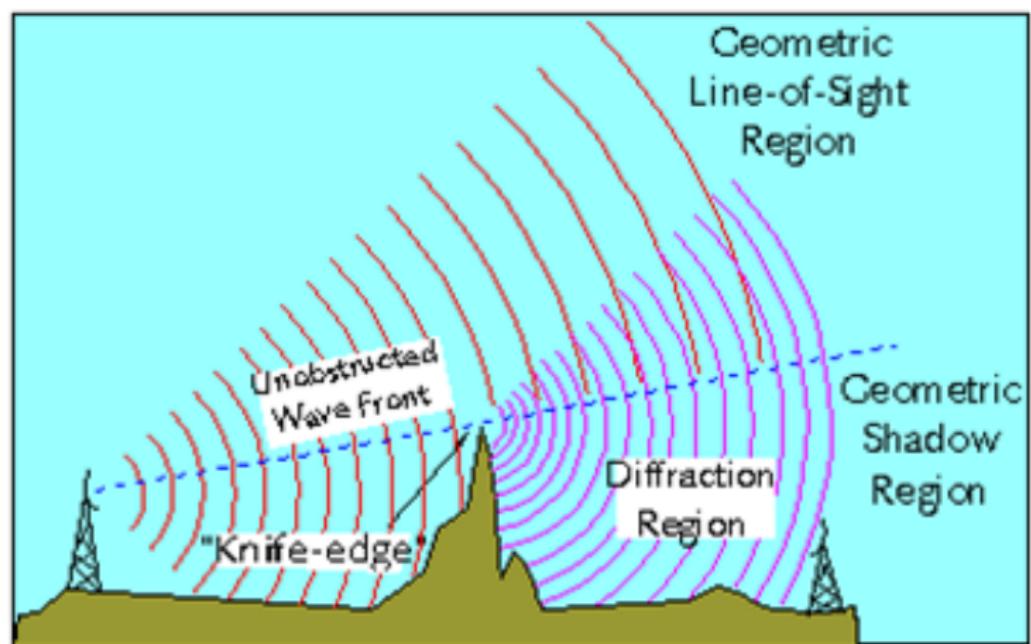
Propagation

T3 Questions

T3A

T3B

T3C



knife-edge effect

Polarization

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

Antennas tend to radiate and receive waves polarized along the direction of the antenna. An antenna pointing vertically produces vertically polarized waves, and the equivalent is true for a horizontal antenna.

If the polarization of the receiving antenna does not match the wave it is receiving then the signal strength is reduced by a significant degree. In an ideal world without the magnetic portion of a wave two antennas rotated $\pm 90^\circ$ would not be able to "see" each other.

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

12 Electromagnetic Waves

13 Propagation

14 T3 Questions

- T3A
- T3B
- T3C

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- 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?
D. Try moving a few feet, as random reflections may be causing multi-path distortion

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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B. The shorter wavelength allows them to more easily penetrate the structure of buildings

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- 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?
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C. Horizontal
- 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?
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Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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B. Try to find a path that reflects signals to the repeater

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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B. Picket fencing

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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A. Electromagnetic

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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D. Try moving a few feet, as random reflections may be causing multi-path distortion
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C. Random combining of signals arriving via different path lengths

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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A. Electromagnetic
- T3A08 What is the cause of irregular fading of signals from distant stations during times of generally good reception?
C. Random combining of signals arriving via different path lengths
- T3A09 Which of the following is a common effect of "skip" reflections between the Earth and the ionosphere?
B. The polarization of the original signal is randomized

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- 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?
D. Try moving a few feet, as random reflections may be causing multi-path distortion
- T3A02 (B) Why are UHF signals often more effective from inside buildings than VHF signals?
B. The shorter wavelength allows them to more easily penetrate the structure of buildings
- T3A03 What antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands?
C. Horizontal
- 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?
B. Signals could be significantly weaker
- 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?
B. Try to find a path that reflects signals to the repeater
- T3A06 What term is commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting?
B. Picket fencing
- T3A07 What type of wave carries radio signals between transmitting and receiving stations?
A. Electromagnetic
- T3A08 What is the cause of irregular fading of signals from distant stations during times of generally good reception?
C. Random combining of signals arriving via different path lengths
- T3A09 Which of the following is a common effect of "skip" reflections between the Earth and the ionosphere?
B. The polarization of the original signal is randomized
- T3A10 What may occur if VHF or UHF data signals propagate over multiple paths?
D. Error rates are likely to increase

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- 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?
D. Try moving a few feet, as random reflections may be causing multi-path distortion
- T3A02 (B) Why are UHF signals often more effective from inside buildings than VHF signals?
B. The shorter wavelength allows them to more easily penetrate the structure of buildings
- T3A03 What antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands?
C. Horizontal
- 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?
B. Signals could be significantly weaker
- 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?
B. Try to find a path that reflects signals to the repeater
- T3A06 What term is commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting?
B. Picket fencing
- T3A07 What type of wave carries radio signals between transmitting and receiving stations?
A. Electromagnetic
- T3A08 What is the cause of irregular fading of signals from distant stations during times of generally good reception?
C. Random combining of signals arriving via different path lengths
- T3A09 Which of the following is a common effect of "skip" reflections between the Earth and the ionosphere?
B. The polarization of the original signal is randomized
- T3A10 What may occur if VHF or UHF data signals propagate over multiple paths?
D. Error rates are likely to increase
- T3A11 Which part of the atmosphere enables the propagation of radio signals around the world?
C. The ionosphere

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

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

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3B01 What is the name for the distance a radio wave travels during one complete cycle?
C. Wavelength
- T3B02 What term describes the number of times per second that an alternating current reverses direction?
D. Frequency

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3B01 What is the name for the distance a radio wave travels during one complete cycle?
C. Wavelength
- T3B02 What term describes the number of times per second that an alternating current reverses direction?
D. Frequency
- T3B03 What are the two components of a radio wave?
C. Electric and magnetic fields

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3B01 What is the name for the distance a radio wave travels during one complete cycle?
C. Wavelength
- T3B02 What term describes the number of times per second that an alternating current reverses direction?
D. Frequency
- T3B03 What are the two components of a radio wave?
C. Electric and magnetic fields
- T3B04 How fast does a radio wave travel through free space?
A. At the speed of light

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3B01 What is the name for the distance a radio wave travels during one complete cycle?
C. Wavelength
- T3B02 What term describes the number of times per second that an alternating current reverses direction?
D. Frequency
- T3B03 What are the two components of a radio wave?
C. Electric and magnetic fields
- T3B04 How fast does a radio wave travel through free space?
A. At the speed of light
- T3B05 How does the wavelength of a radio wave relate to its frequency?
B. The wavelength gets shorter as the frequency increases

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3B01 What is the name for the distance a radio wave travels during one complete cycle?**
C. Wavelength
- T3B02 What term describes the number of times per second that an alternating current reverses direction?**
D. Frequency
- T3B03 What are the two components of a radio wave?**
C. Electric and magnetic fields
- T3B04 How fast does a radio wave travel through free space?**
A. At the speed of light
- T3B05 How does the wavelength of a radio wave relate to its frequency?**
B. The wavelength gets shorter as the frequency increases
- T3B06 What is the formula for converting frequency to wavelength in meters?**
D. Wavelength in meters equals 300 divided by frequency in megahertz

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3B01 What is the name for the distance a radio wave travels during one complete cycle?**
C. Wavelength
- T3B02 What term describes the number of times per second that an alternating current reverses direction?**
D. Frequency
- T3B03 What are the two components of a radio wave?**
C. Electric and magnetic fields
- T3B04 How fast does a radio wave travel through free space?**
A. At the speed of light
- T3B05 How does the wavelength of a radio wave relate to its frequency?**
B. The wavelength gets shorter as the frequency increases
- T3B06 What is the formula for converting frequency to wavelength in meters?**
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

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3B01 What is the name for the distance a radio wave travels during one complete cycle?**
C. Wavelength
- T3B02 What term describes the number of times per second that an alternating current reverses direction?**
D. Frequency
- T3B03 What are the two components of a radio wave?**
C. Electric and magnetic fields
- T3B04 How fast does a radio wave travel through free space?**
A. At the speed of light
- T3B05 How does the wavelength of a radio wave relate to its frequency?**
B. The wavelength gets shorter as the frequency increases
- T3B06 What is the formula for converting frequency to wavelength in meters?**
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
- T3B08 What are the frequency limits of the VHF spectrum?**
B. 30 to 300 MHz

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3B01 What is the name for the distance a radio wave travels during one complete cycle?
C. Wavelength
- T3B02 What term describes the number of times per second that an alternating current reverses direction?
D. Frequency
- T3B03 What are the two components of a radio wave?
C. Electric and magnetic fields
- T3B04 How fast does a radio wave travel through free space?
A. At the speed of light
- T3B05 How does the wavelength of a radio wave relate to its frequency?
B. The wavelength gets shorter as the frequency increases
- T3B06 What is the formula for converting frequency to wavelength in meters?
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
- T3B08 What are the frequency limits of the VHF spectrum?
B. 30 to 300 MHz
- T3B09 What are the frequency limits of the UHF spectrum?
D. 300 to 3000 MHz

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3B01 What is the name for the distance a radio wave travels during one complete cycle?
C. Wavelength
- T3B02 What term describes the number of times per second that an alternating current reverses direction?
D. Frequency
- T3B03 What are the two components of a radio wave?
C. Electric and magnetic fields
- T3B04 How fast does a radio wave travel through free space?
A. At the speed of light
- T3B05 How does the wavelength of a radio wave relate to its frequency?
B. The wavelength gets shorter as the frequency increases
- T3B06 What is the formula for converting frequency to wavelength in meters?
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
- T3B08 What are the frequency limits of the VHF spectrum?
B. 30 to 300 MHz
- T3B09 What are the frequency limits of the UHF spectrum?
D. 300 to 3000 MHz
- T3B10 What frequency range is referred to as HF?
C. 3 to 30 MHz

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3B01 What is the name for the distance a radio wave travels during one complete cycle?
C. Wavelength
- T3B02 What term describes the number of times per second that an alternating current reverses direction?
D. Frequency
- T3B03 What are the two components of a radio wave?
C. Electric and magnetic fields
- T3B04 How fast does a radio wave travel through free space?
A. At the speed of light
- T3B05 How does the wavelength of a radio wave relate to its frequency?
B. The wavelength gets shorter as the frequency increases
- T3B06 What is the formula for converting frequency to wavelength in meters?
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
- T3B08 What are the frequency limits of the VHF spectrum?
B. 30 to 300 MHz
- T3B09 What are the frequency limits of the UHF spectrum?
D. 300 to 3000 MHz
- T3B10 What frequency range is referred to as HF?
C. 3 to 30 MHz
- T3B11 What is the approximate velocity of a radio wave as it travels through free space?
B. 300,000,000 meters per second

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere
- T3C02 Which of the following might be happening when VHF signals are being received from long distances?
D. Signals are being refracted from a sporadic E layer

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere
- T3C02 Which of the following might be happening when VHF signals are being received from long distances?
D. Signals are being refracted from a sporadic E layer
- T3C03 What is a characteristic of VHF signals received via auroral reflection?
B. The signals exhibit rapid fluctuations of strength and often sound distorted

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere
- T3C02 Which of the following might be happening when VHF signals are being received from long distances?
D. Signals are being refracted from a sporadic E layer
- T3C03 What is a characteristic of VHF signals received via auroral reflection?
B. The signals exhibit rapid fluctuations of strength and often sound distorted
- 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?
B. Sporadic E

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere
- T3C02 Which of the following might be happening when VHF signals are being received from long distances?
D. Signals are being refracted from a sporadic E layer
- T3C03 What is a characteristic of VHF signals received via auroral reflection?
B. The signals exhibit rapid fluctuations of strength and often sound distorted
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- T3C05 What is meant by the term "knife-edge" propagation?
C. Signals are partially refracted around solid objects exhibiting sharp edges

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere
- T3C02 Which of the following might be happening when VHF signals are being received from long distances?
D. Signals are being refracted from a sporadic E layer
- T3C03 What is a characteristic of VHF signals received via auroral reflection?
B. The signals exhibit rapid fluctuations of strength and often sound distorted
- 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?
B. Sporadic E
- T3C05 What is meant by the term "knife-edge" propagation?
C. Signals are partially refracted around solid objects exhibiting sharp edges
- 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

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere
- T3C02 Which of the following might be happening when VHF signals are being received from long distances?
D. Signals are being refracted from a sporadic E layer
- T3C03 What is a characteristic of VHF signals received via auroral reflection?
B. The signals exhibit rapid fluctuations of strength and often sound distorted
- 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?
B. Sporadic E
- T3C05 What is meant by the term "knife-edge" propagation?
C. Signals are partially refracted around solid objects exhibiting sharp edges
- 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
- T3C07 What band is best suited to communicating via meteor scatter?
B. 6 meters

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere
- T3C02 Which of the following might be happening when VHF signals are being received from long distances?
D. Signals are being refracted from a sporadic E layer
- T3C03 What is a characteristic of VHF signals received via auroral reflection?
B. The signals exhibit rapid fluctuations of strength and often sound distorted
- 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?
B. Sporadic E
- T3C05 What is meant by the term "knife-edge" propagation?
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- 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
- T3C07 What band is best suited to communicating via meteor scatter?
B. 6 meters
- T3C08 What causes "tropospheric ducting"?
D. Temperature inversions in the atmosphere

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere
- T3C02 Which of the following might be happening when VHF signals are being received from long distances?
D. Signals are being refracted from a sporadic E layer
- T3C03 What is a characteristic of VHF signals received via auroral reflection?
B. The signals exhibit rapid fluctuations of strength and often sound distorted
- 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?
B. Sporadic E
- T3C05 What is meant by the term "knife-edge" propagation?
C. Signals are partially refracted around solid objects exhibiting sharp edges
- 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
- T3C07 What band is best suited to communicating via meteor scatter?
B. 6 meters
- T3C08 What causes "tropospheric ducting"?
D. Temperature inversions in the atmosphere
- T3C09 What is generally the best time for long-distance 10 meter band propagation?
A. During daylight hours

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere
- T3C02 Which of the following might be happening when VHF signals are being received from long distances?
D. Signals are being refracted from a sporadic E layer
- T3C03 What is a characteristic of VHF signals received via auroral reflection?
B. The signals exhibit rapid fluctuations of strength and often sound distorted
- 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?
B. Sporadic E
- T3C05 What is meant by the term "knife-edge" propagation?
C. Signals are partially refracted around solid objects exhibiting sharp edges
- 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
- T3C07 What band is best suited to communicating via meteor scatter?
B. 6 meters
- T3C08 What causes "tropospheric ducting"?
D. Temperature inversions in the atmosphere
- T3C09 What is generally the best time for long-distance 10 meter band propagation?
A. During daylight hours
- 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

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Electromagnetic
Waves

Propagation

T3 Questions

T3A

T3B

T3C

- T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
C. UHF signals are usually not reflected by the ionosphere
- T3C02 Which of the following might be happening when VHF signals are being received from long distances?
D. Signals are being refracted from a sporadic E layer
- T3C03 What is a characteristic of VHF signals received via auroral reflection?
B. The signals exhibit rapid fluctuations of strength and often sound distorted
- 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?
B. Sporadic E
- T3C05 What is meant by the term "knife-edge" propagation?
C. Signals are partially refracted around solid objects exhibiting sharp edges
- 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
- T3C07 What band is best suited to communicating via meteor scatter?
B. 6 meters
- T3C08 What causes "tropospheric ducting"?
D. Temperature inversions in the atmosphere
- T3C09 What is generally the best time for long-distance 10 meter band propagation?
A. During daylight hours
- 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
- T3C11 Why do VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations?
C. The Earth seems less curved to radio waves than to light

Technician class section 4

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions
T4A
T4B

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A
T4B

- 15 Station setup; microphone, speaker, headphones, filters, power source, connecting a computer, RF grounding
- 16 Operating controls; tuning, use of filters, squelch, AGC, repeater offset, memory channels
- 17 T4 Questions
 - T4A
 - T4B

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

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

Operating
controls; tuning,
use of filters,
squench, AGC,
repeater offset,
memory channels

T4 Questions

T4A
T4B

Some microphones include push-to-talk and voltage connections. Headphones can be useful in a noisy area instead of a speaker. A regulated power supply reduces voltage fluctuations. Filters between the transmitter and antenna can reduce harmonic emissions. A band-reject filter is a good first step if your 2 meter radio is causing problems with a TV. A terminal node controller is a modem for your radio, your soundcard can be a modem too. Flat straps are good grounding cables. Ferrite chokes can reduce RF current in cables. If your radio whines in your car and it goes along with the engine its probably the alternator. A radio installed in a car should be connected to a good "ground"

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

Operating
controls; tuning,
use of filters,
squench, AGC,
repeater offset,
memory channels

T4 Questions

T4A
T4B

- 15 Station setup; microphone, speaker, headphones, filters, power source, connecting a computer, RF grounding
- 16 Operating controls; tuning, use of filters, squelch, AGC, repeater offset, memory channels
- 17 T4 Questions
 - T4A
 - T4B

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

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A
T4B

If your mic is turned up to loud your signal may distort. You can set the frequency of a radio with the keypad or VFO knob. Squelch lets you mute the receiver when no signal is coming in. You can program favorite frequencies in memory. The noise blanker option can reduce noise. The RIT or Receiver Incremental Tuning control can change the pitch of the received audio. A good filter setting for SSB is 2400Hz, and 500Hz for CW. A repeater offset is the difference in its receive and transmit frequencies.

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A
T4B

- 15 Station setup; microphone, speaker, headphones, filters, power source, connecting a computer, RF grounding
- 16 Operating controls; tuning, use of filters, squelch, AGC, repeater offset, memory channels
- 17 T4 Questions
 - T4A
 - T4B

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A

T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A

T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone
- T4A02 (C) What could be used in place of a regular speaker to help you copy signals in a noisy area?
C. A set of headphones

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A

T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone
- T4A02 (C) What could be used in place of a regular speaker to help you copy signals in a noisy area?
C. A set of headphones
- T4A03 (A) Which is a good reason to use a regulated power supply for communications equipment?
A. It prevents voltage fluctuations from reaching sensitive circuits

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

Operating
controls; tuning,
use of filters,
squench, AGC,
repeater offset,
memory channels

T4 Questions

T4A

T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone
- T4A02 (C) What could be used in place of a regular speaker to help you copy signals in a noisy area?
C. A set of headphones
- T4A03 (A) Which is a good reason to use a regulated power supply for communications equipment?
A. It prevents voltage fluctuations from reaching sensitive circuits
- T4A04 (A) Where must a filter be installed to reduce harmonic emissions?
A. Between the transmitter and the antenna

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions
T4A
T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone
- T4A02 (C) What could be used in place of a regular speaker to help you copy signals in a noisy area?
C. A set of headphones
- T4A03 (A) Which is a good reason to use a regulated power supply for communications equipment?
A. It prevents voltage fluctuations from reaching sensitive circuits
- T4A04 (A) Where must a filter be installed to reduce harmonic emissions?
A. Between the transmitter and the antenna
- T4A05 (D) 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?
D. Band-reject filter

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A

T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone
- T4A02 (C) What could be used in place of a regular speaker to help you copy signals in a noisy area?
C. A set of headphones
- T4A03 (A) Which is a good reason to use a regulated power supply for communications equipment?
A. It prevents voltage fluctuations from reaching sensitive circuits
- T4A04 (A) Where must a filter be installed to reduce harmonic emissions?
A. Between the transmitter and the antenna
- T4A05 (D) 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?
D. Band-reject filter
- T4A06 (C) Which of the following would be connected between a transceiver and computer in a packet radio station?
C. Terminal node controller

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A

T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone
- T4A02 (C) What could be used in place of a regular speaker to help you copy signals in a noisy area?
C. A set of headphones
- T4A03 (A) Which is a good reason to use a regulated power supply for communications equipment?
A. It prevents voltage fluctuations from reaching sensitive circuits
- T4A04 (A) Where must a filter be installed to reduce harmonic emissions?
A. Between the transmitter and the antenna
- T4A05 (D) 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?
D. Band-reject filter
- T4A06 (C) Which of the following would be connected between a transceiver and computer in a packet radio station?
C. Terminal node controller
- T4A07 (C) How is the computer's sound card used when conducting digital communications using a computer?
C. The sound card provides audio to the microphone input and converts received audio to digital form

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A

T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone
- T4A02 (C) What could be used in place of a regular speaker to help you copy signals in a noisy area?
C. A set of headphones
- T4A03 (A) Which is a good reason to use a regulated power supply for communications equipment?
A. It prevents voltage fluctuations from reaching sensitive circuits
- T4A04 (A) Where must a filter be installed to reduce harmonic emissions?
A. Between the transmitter and the antenna
- T4A05 (D) 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?
D. Band-reject filter
- T4A06 (C) Which of the following would be connected between a transceiver and computer in a packet radio station?
C. Terminal node controller
- T4A07 (C) How is the computer's sound card used when conducting digital communications using a computer?
C. The sound card provides audio to the microphone input and converts received audio to digital form
- T4A08 (D) Which type of conductor is best to use for RF grounding?
D. Flat strap

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

Operating
controls; tuning,
use of filters,
squench, AGC,
repeater offset,
memory channels

T4 Questions

T4A
T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone
- T4A02 (C) What could be used in place of a regular speaker to help you copy signals in a noisy area?
C. A set of headphones
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A. It prevents voltage fluctuations from reaching sensitive circuits
- T4A04 (A) Where must a filter be installed to reduce harmonic emissions?
A. Between the transmitter and the antenna
- T4A05 (D) 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?
D. Band-reject filter
- T4A06 (C) Which of the following would be connected between a transceiver and computer in a packet radio station?
C. Terminal node controller
- T4A07 (C) How is the computer's sound card used when conducting digital communications using a computer?
C. The sound card provides audio to the microphone input and converts received audio to digital form
- T4A08 (D) Which type of conductor is best to use for RF grounding?
D. Flat strap
- T4A09 (D) Which would you use to reduce RF current flowing on the shield of an audio cable?
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Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

Operating
controls; tuning,
use of filters,
squench, AGC,
repeater offset,
memory channels

T4 Questions

T4A

T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone
- T4A02 (C) What could be used in place of a regular speaker to help you copy signals in a noisy area?
C. A set of headphones
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A. Between the transmitter and the antenna
- T4A05 (D) 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?
D. Band-reject filter
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C. Terminal node controller
- T4A07 (C) How is the computer's sound card used when conducting digital communications using a computer?
C. The sound card provides audio to the microphone input and converts received audio to digital form
- T4A08 (D) Which type of conductor is best to use for RF grounding?
D. Flat strap
- T4A09 (D) Which would you use to reduce RF current flowing on the shield of an audio cable?
D. Ferrite choke
- T4A10 (B) What is the source of a high-pitched whine that varies with engine speed in a mobile transceiver's receive audio?
B. The alternator

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

Operating
controls; tuning,
use of filters,
squench, AGC,
repeater offset,
memory channels

T4 Questions
T4A
T4B

- TA01 (B) Which of the following is true concerning the microphone connectors on amateur transceivers?
B. Some connectors include push-to-talk and voltages for powering the microphone
- T4A02 (C) What could be used in place of a regular speaker to help you copy signals in a noisy area?
C. A set of headphones
- T4A03 (A) Which is a good reason to use a regulated power supply for communications equipment?
A. It prevents voltage fluctuations from reaching sensitive circuits
- T4A04 (A) Where must a filter be installed to reduce harmonic emissions?
A. Between the transmitter and the antenna
- T4A05 (D) 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?
D. Band-reject filter
- T4A06 (C) Which of the following would be connected between a transceiver and computer in a packet radio station?
C. Terminal node controller
- T4A07 (C) How is the computer's sound card used when conducting digital communications using a computer?
C. The sound card provides audio to the microphone input and converts received audio to digital form
- T4A08 (D) Which type of conductor is best to use for RF grounding?
D. Flat strap
- T4A09 (D) Which would you use to reduce RF current flowing on the shield of an audio cable?
D. Ferrite choke
- T4A10 (B) What is the source of a high-pitched whine that varies with engine speed in a mobile transceiver's receive audio?
B. The alternator
- T4A11 (A) Where should a mobile transceiver's power negative connection be made?
A. At the battery or engine block ground strap

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions
T4A
T4B

- T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?
B. The output signal might become distorted

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A

T4B

- **T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?**
B. The output signal might become distorted
- **T4B02 (A) Which of the following can be used to enter the operating frequency on a modern transceiver?**
A. The keypad or VFO knob

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A

T4B

- **T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?**
B. The output signal might become distorted
- **T4B02 (A) Which of the following can be used to enter the operating frequency on a modern transceiver?**
A. The keypad or VFO knob
- **T4B03 (D) What is the purpose of the squelch control on a transceiver?**
D. To mute receiver output noise when no signal is being received

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions

T4A
T4B

- **T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?**
B. The output signal might become distorted
- **T4B02 (A) Which of the following can be used to enter the operating frequency on a modern transceiver?**
A. The keypad or VFO knob
- **T4B03 (D) What is the purpose of the squelch control on a transceiver?**
D. To mute receiver output noise when no signal is being received
- **T4B04 (B) What is a way to enable quick access to a favorite frequency on your transceiver?**
B. Store the frequency in a memory channel

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions
T4A
T4B

- T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?**
B. The output signal might become distorted
- T4B02 (A) Which of the following can be used to enter the operating frequency on a modern transceiver?**
A. The keypad or VFO knob
- T4B03 (D) What is the purpose of the squelch control on a transceiver?**
D. To mute receiver output noise when no signal is being received
- T4B04 (B) What is a way to enable quick access to a favorite frequency on your transceiver?**
B. Store the frequency in a memory channel
- T4B05 (C) Which of the following would reduce ignition interference to a receiver?**
C. Turn on the noise blanker

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions
T4A
T4B

- T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?**
B. The output signal might become distorted
- T4B02 (A) Which of the following can be used to enter the operating frequency on a modern transceiver?**
A. The keypad or VFO knob
- T4B03 (D) What is the purpose of the squelch control on a transceiver?**
D. To mute receiver output noise when no signal is being received
- T4B04 (B) What is a way to enable quick access to a favorite frequency on your transceiver?**
B. Store the frequency in a memory channel
- T4B05 (C) Which of the following would reduce ignition interference to a receiver?**
C. Turn on the noise blanker
- T4B06 (D) Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?**
D. The receiver RIT or clarifier

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

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

T4 Questions
T4A
T4B

- T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?
B. The output signal might become distorted
- T4B02 (A) Which of the following can be used to enter the operating frequency on a modern transceiver?
A. The keypad or VFO knob
- T4B03 (D) What is the purpose of the squelch control on a transceiver?
D. To mute receiver output noise when no signal is being received
- T4B04 (B) What is a way to enable quick access to a favorite frequency on your transceiver?
B. Store the frequency in a memory channel
- T4B05 (C) Which of the following would reduce ignition interference to a receiver?
C. Turn on the noise blanker
- T4B06 (D) Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?
D. The receiver RIT or clarifier
- T4B07 (B) What does the term "RIT" mean?
B. Receiver Incremental Tuning

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

Operating
controls; tuning,
use of filters,
squench, AGC,
repeater offset,
memory channels

T4 Questions

T4A

T4B

- **T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?**
B. The output signal might become distorted
- **T4B02 (A) Which of the following can be used to enter the operating frequency on a modern transceiver?**
A. The keypad or VFO knob
- **T4B03 (D) What is the purpose of the squelch control on a transceiver?**
D. To mute receiver output noise when no signal is being received
- **T4B04 (B) What is a way to enable quick access to a favorite frequency on your transceiver?**
B. Store the frequency in a memory channel
- **T4B05 (C) Which of the following would reduce ignition interference to a receiver?**
C. Turn on the noise blanker
- **T4B06 (D) Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?**
D. The receiver RIT or clarifier
- **T4B07 (B) What does the term "RIT" mean?**
B. Receiver Incremental Tuning
- **T4B08 (B) What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?**
B. Permits noise or interference reduction by selecting a bandwidth matching the mode

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

Operating
controls; tuning,
use of filters,
squench, AGC,
repeater offset,
memory channels

T4 Questions

T4A

T4B

- T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?**
B. The output signal might become distorted
- T4B02 (A) Which of the following can be used to enter the operating frequency on a modern transceiver?**
A. The keypad or VFO knob
- T4B03 (D) What is the purpose of the squelch control on a transceiver?**
D. To mute receiver output noise when no signal is being received
- T4B04 (B) What is a way to enable quick access to a favorite frequency on your transceiver?**
B. Store the frequency in a memory channel
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C. Turn on the noise blanker
- T4B06 (D) Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?**
D. The receiver RIT or clarifier
- T4B07 (B) What does the term "RIT" mean?**
B. Receiver Incremental Tuning
- T4B08 (B) What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?**
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- T4B09 (C) Which of the following is an appropriate receive filter to select in order to minimize noise and interference for SSB reception?**
C. 2400 Hz

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

Operating
controls; tuning,
use of filters,
squench, AGC,
repeater offset,
memory channels

T4 Questions
T4A
T4B

- T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?
B. The output signal might become distorted
- T4B02 (A) Which of the following can be used to enter the operating frequency on a modern transceiver?
A. The keypad or VFO knob
- T4B03 (D) What is the purpose of the squelch control on a transceiver?
D. To mute receiver output noise when no signal is being received
- T4B04 (B) What is a way to enable quick access to a favorite frequency on your transceiver?
B. Store the frequency in a memory channel
- T4B05 (C) Which of the following would reduce ignition interference to a receiver?
C. Turn on the noise blanker
- T4B06 (D) Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?
D. The receiver RIT or clarifier
- T4B07 (B) What does the term "RIT" mean?
B. Receiver Incremental Tuning
- T4B08 (B) What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?
B. Permits noise or interference reduction by selecting a bandwidth matching the mode
- T4B09 (C) Which of the following is an appropriate receive filter to select in order to minimize noise and interference for SSB reception?
C. 2400 Hz
- T4B10 (A) Which of the following is an appropriate receive filter to select in order to minimize noise and interference for CW reception?
A. 500 Hz

Title

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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

Operating
controls; tuning,
use of filters,
squench, AGC,
repeater offset,
memory channels

T4 Questions
T4A
T4B

- T4B01 (B) What may happen if a transmitter is operated with the microphone gain set too high?
B. The output signal might become distorted
- T4B02 (A) Which of the following can be used to enter the operating frequency on a modern transceiver?
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D. To mute receiver output noise when no signal is being received
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B. Store the frequency in a memory channel
- T4B05 (C) Which of the following would reduce ignition interference to a receiver?
C. Turn on the noise blanker
- T4B06 (D) Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?
D. The receiver RIT or clarifier
- T4B07 (B) What does the term "RIT" mean?
B. Receiver Incremental Tuning
- T4B08 (B) What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?
B. Permits noise or interference reduction by selecting a bandwidth matching the mode
- T4B09 (C) Which of the following is an appropriate receive filter to select in order to minimize noise and interference for SSB reception?
C. 2400 Hz
- T4B10 (A) Which of the following is an appropriate receive filter to select in order to minimize noise and interference for CW reception?
A. 500 Hz
- T4B11 (C) Which of the following describes the common meaning of the term repeater offset ?
C. The difference between the repeater's transmit and receive frequencies

Table of Contents

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

Ohm's Law
Current
Voltage
Resistance

18

Ohm's Law

- Current
- Voltage
- Resistance

Ohm, Ohm on the range

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Ohm's Law
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Most metals are good at conducting electricity, this means they allow electrons to move around. We make wires that allow us to move electrons from one specific place to another.

Current

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The movement of electrons is called **Current**. We measure current in the Ampere, aka the Amp, aka A (or I).

Current that moves in only one direction is called **Direct Current (DC)**. Current that changes direction regularly is called **Alternating Current (AC)**.

A device that measures current is an ammeter.

Ideas of current

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Current
Voltage
Resistance



Ideas of current

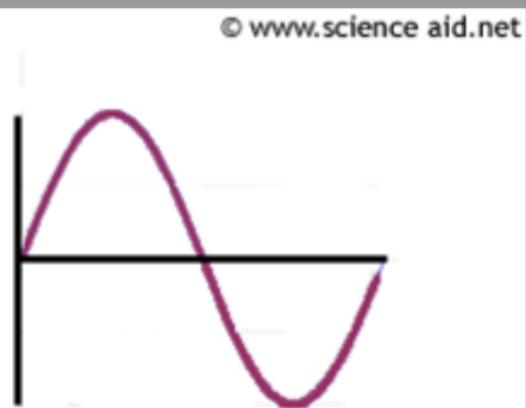
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Resistance



Direct Current



Alternating Current

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The Electromotive Force

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The force that causes electrons to flow is called . . .

The Electromotive Force

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Voltage
Resistance

The force that causes electrons to flow is called **The Electromotive Force.**

We measure this force as ...

The Electromotive Force

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Ohm's Law
Current
Voltage
Resistance

The force that causes electrons to flow is called **The Electromotive Force.**

We measure this force as **Voltage**, or **V**.

Voltage is measured with a ...

The Electromotive Force

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Ohm's Law
Current
Voltage
Resistance

The force that causes electrons to flow is called **The Electromotive Force.**

We measure this force as **Voltage**, or **V**.
Voltage is measured with a **Voltmeter**

Voltage

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Ohm's Law
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Voltage
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Electrons like to spread out. It's their "natural desire" to not get bunched up that causes voltage. There can be voltage without current, but not current without voltage.

An unconnected battery has a voltage, but until it is hooked up to a complete circuit the electrons can't go anywhere.

The Resistor

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Ohm's Law
Current
Voltage
Resistance

The resistor, resists or impedes the flow of electrons.
The unit of resistance is the Ohm, or Ω .

The Resistor

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Amateur Radio
& Satellite Stuff

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Amateur Extra

Ohm's Law
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Resistance

The resistor, resists or impedes the flow of electrons.

The unit of resistance is the Ohm, or Ω . If that looks Greek, that's because it is, that Omega, a letter from the Greek alphabet

The Resistor

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General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenthal,
KE7OSN
Amateur Extra

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Now sing along ...

Alpha *A*, Beta *B*, Gamma Γ , Delta Δ , Epsilon *E*, Zeta *Z*, Eta *H*,
Theta Θ , Iota *I*.

Anyone?

The Resistor

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Ohm's Law
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Resistance

The resistor, resists or impedes the flow of electrons.

The unit of resistance is the Ohm, or Ω . If that looks Greek, that's because it is, that Omega, a letter from the Greek alphabet
Resistance is measured with an ohmmeter.



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Voltage
Resistance

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Current
Voltage
Resistance

Title

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Amateur Radio
& Satellite Stuff

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Current
Voltage
Resistance

Title

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General Class
Amateur Radio
& Satellite Stuff

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Amateur Extra

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Current
Voltage
Resistance

Title

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General Class
Amateur Radio
& Satellite Stuff

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Current
Voltage
Resistance

Title

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General Class
Amateur Radio
& Satellite Stuff

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