Mobile Training Institute

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MTI was founded in 1960 by Motorola Communications and Electronics, Inc. — when they recognized the need for specialized training in professional FM Two-Way radio. MTI now operates independently of Motorola, but the emphasis remains the same. Prior to MTI’s inception, no training program adequately covered the technical aspects of this unique communications medium. MTI has solved this problem.

There are advantages to home study electronics training beyond the technical knowledge you will receive. With a home study program, you have the ability to establish your own study schedule to coincide with other activities and work schedules. You set your own progress rate and meet your own deadlines, while at the same time, you become more self-reliant. As you learn to dig out the facts through the MTI course, the knowledge you gain will be better understood and retained — because you actually taught yourself.

Two-way radio technicians in the United States must have a valid FCC commercial license, other than third class, to service non-governmental transmitters. While the MTI course is not designed as a study program for obtaining the FCC license, it does contain information that is helpful in passing the FCC exam. Many inexpensive FCC license study guides are available.

Two-way radio has long been accepted as a proven tool for business, industry and public service institutions. Radio provides constant communication between management and personnel. Once restricted to limited use by police, fire and military personnel, today anyone who shows the need for two-way radio can use its advantages to great benefit.

These millions of radios require competent, continuing maintenance to keep them at peak performance levels. Many systems are vital to public health and safety. They must be operating at all times. This requires many two-way technicians. Perhaps the industry can use your talents.

MTI offers 34 specific lessons for professional FM two-way radio technicians. MTI has the only training program exclusively devoted to professional FM two-way radio communications, with the added bonus that circuits from two-way products are used to illustrate various principles. To keep the MTI program current, a revision of the course content has just been completed. MTI wants you to have the latest knowledge available from the ever-changing field of electronics, so that you will be up-to-date in your skills.
FM Two-Way Radio Servicing

Course Outline

Lesson 1: FM TRANSMITTER
- Theory of operation
- Modulation circuits
- Frequency modulation
- Amplitude modulation
- LESSON 1-1 FM MODULATION
- MODULATION LESSON R-1, FREQUENCY

Lesson 2: RECEIVER BLOCK
- Receiver design
- Preselector circuits
- Gain stages
- IF stages
- Audio stages
- LESSON 2-1 RECEIVER BLOCK

Lesson 3: RF SECTION
- RF components
- Antenna systems
- Frequency stability
- Interference
- LESSON 3-1 RF SECTION

Lesson 4: OSCILLATOR MIXER
- Oscillator circuits
- Mixer circuits
- PLL circuits
- LESSON 4-1 OSCILLATOR MIXER

Lesson 5: SECOND MIXER AND IF BOARD
- Second mixer circuits
- IF board design
- IF filters
- LESSON 5-1 SECOND MIXER AND IF BOARD

Lesson 6: THE DISCRIMINATOR
- Discriminator theory
- Discriminator circuits
- Discriminator response
- LESSON 6-1 THE DISCRIMINATOR

Lesson 7: THE LIMITER
- Limiter theory
- Limiter circuits
- Limiter operation
- LESSON 7-1 THE LIMITER

Lesson 8: SQUELCH AND AUDIO
- Squelch theory
- Audio circuits
- Audio amplifiers
- LESSON 8-1 SQUELCH AND AUDIO

Lesson 9: THE METER IN THE RECEIVER
- Meter theory
- Meter circuits
- Meter operation
- LESSON 9-1 THE METER IN THE RECEIVER

Lesson 10: RECEIVER
- Receiver design
- Receiver circuits
- Receiver operation
- LESSON 10-1 RECEIVER

34 LESSONS, PLUS 13 REFERENCE TEXTS
The MTI program is designed for two major categories of technicians: those already employed in two-way radio servicing and those planning to enter this field. Because no other training is available that deals so specifically with this subject, most working technicians have "picked up" much of their knowledge through experience. The MTI course helps to expand this knowledge and to clarify or correct information acquired through observation.

The course offers the technician with no experience in two-way radio an opportunity to acquire a knowledge of the subject that would likely require years of on-the-job experience to obtain. Thus, they can become usefully productive in a shorter period of time. There are other categories of students who can benefit from the course as well.

WHO SHOULD ENROLL?

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PURPOSE OF THE COURSE

The purpose of the course is to provide a reasonably detailed analysis of the major components of an FM two-way radio system for the servicing technician. For this reason, mathematical analysis is avoided and a functional emphasis is stressed. Explanations are made in such a manner that the functions of a particular circuit are established and the relationship of its individual components to the whole is clarified. The desired purpose is to develop a type of working knowledge that will aid the technician when troubleshooting a malfunctioning unit. Because of the rapidity with which change occurs in electronics, more emphasis is placed on logical comprehension than on specific circuits.

The desired goal is to have the student better qualified to service FM two-way radios when they complete the course than when they started. MTI, to the best of our knowledge, has the only course that exclusively covers this specialized profession. It is written by people with extensive field experience for people who are working in the field.

Because of the possibilities for misunderstanding, we do not consider the acquisition of a job in this field, job promotions, salary increases and similar objectives as suitable goals to be promoted in our advertising. Such things are difficult to measure and can depend more upon economics, the job market, the individual’s personality and perseverance, geographic location and similar matters.

THE MTI COURSE

MTI has one course which is offered in three options. These are:

COURSE D: Principles of Semiconductors. This includes the first 4 lessons of the course plus one reference text. It provides a background in both bipolar and unipolar (field effect) transistors, IC’s, operational amplifiers and other solid state devices. Originally intended to upgrade the technician with experience in tube equipment, it also serves as a preparation for the other 30 lessons. It strengthens the students knowledge of semiconductor principles. These 4 lessons and one reference can stand alone as a separate course to provide the student with an overview of transistors and other semiconductor devices.

COURSE B: Professional FM Two-Way Mobile Radio, consists of the last 30 lessons of the course with 11 of the references. Nine major areas of study are covered: receivers, transmitters, power supplies, antennas, tone signaling, troubleshooting, test equipment, equipment installation, and preventive maintenance.

The lessons are supplemented by 11 references, selected to provide basic and detailed information about various subjects discussed in the lessons. This system keeps the lessons themselves free of unnecessarily detailed or complex material, permitting the individual lesson to be understood more easily. These supplemental texts allow the student to pursue further those areas where he may be weak or have a special interest. The individual student is allowed some latitude in determining the depth with which he pursues the course.

COURSE F: FM Two-Way Radio Servicing, is a complete 34-lesson course, and is the combination of courses D and B. Thirteen references are supplied with this course.
WHY HOME STUDY?

Only a relatively small number of adults are able to take time away from their everyday responsibility of earning a living to attend a resident school. Basically, it is simply a matter of finances. What they are earning in their present job is required for day-to-day living expenses, family support, etc. Also, there is the rather sizable tuition costs and other fees that must be paid in addition to living expenses when attending a resident school. Those who would like to study professional FM two-way radio must also face the question of: "Where would I study?" There are few resident schools that provide any training in two-way radio. No other correspondence school has a detailed course devoted exclusively to FM two-way radio.

For such people, the MTI home-study courses offer an excellent alternative, with home study, no job time is lost and they maintain their present earning ability. The cost is low, and can be paid over a period of time. Add to these the fact that there is no relocation to unfamiliar surroundings, no commuting or similar problems, and home study looks even more attractive.

In addition to the technical knowledge you will receive from the MTI course, there are other advantages to a home study program. First, you are able to establish your own study schedule to fit with your other activities and work schedule. You are not required to attend a class at certain hours, and you will not be penalized should you find it necessary to temporarily discontinue your studies for a few days or more; you can make them up later when you have more time. In a home study program, you are allowed to set your own progress rate and are not tied down to a schedule which you must meet.

Furthermore, we all know that individuals progress at different speeds. Home study automatically takes care of this difference; you are not required to keep pace with a class when you want to take a little extra time to review some principle which was never too clear to you, and you are not held back by a class when you encounter something that you already know.

Another advantage of home study training is that you learn to make your own decisions. You become more self-reliant. There is nobody at your side to prod you along when you have some problem; you will learn to dig out the facts for yourself. Knowledge gained in this fashion is better understood and longer remembered.

If you are "stuck" on something, all is not lost. Simply send us a report of your problem, making the nature of the question as clear as possible. We will be glad to give you the help you need. Many times you will answer your own question by the mere fact that you have clearly defined it.

While correspondence study permits great flexibility and many personal decisions, you still have the benefits of an organized program and curriculum. Actually, all three ingredients of a learning situation are present: the student, the instructor and the instructional material. The major difference between correspondence study and classroom study is that communication between the student and teacher takes place with the written word instead of the spoken word.
There is a ten-question exam with each lesson to help you comprehend the material. An Answer Sheet is returned with your graded exam, and explains each answer.
A Comprehensive Final Examination is used to test what you have learned. This is an open book exam. Successful completion of the course is rewarded with an attractive Certificate of Achievement.
is coupled to the tapped secondary, which feeds the two ceramic resonators (Y1 and Y2). Their frequencies are 448.5 and 461.3 KHz. The secondary of T1 and the two resonators form a bridge circuit. The input to the bridge being the two ends of the T1 secondary coil. The output is taken from the tap of T1 (ground) and the junction of Y1 and Y2.

The resonators have sharp attenuation beyond ±6 KHz of 455 KHz. The filter's overall 3dB bandwidth is 12 KHz. A 455 KHz signal will cause both resonators to conduct an equal amount. When the frequency shifts, one resonator will have lower output and the output of the other will increase. The addition of these two outputs will approximate the on-frequency output. Beyond ±6 KHz only one crystal will conduct and the output will drop sharply. C30 is used to tune the bridge for balance, which is actually the point of minimum output (maximum rejection).

The output of this first section is coupled to a tap on L10, which with C31 and C32 form a resonant circuit tuned to 456 KHz, providing additional selectivity. The tap provides the required impedance match. The input to the second section of the filter is between the junction of Y3, Y4 and the tap of T2. This section performs the same as the first section. C33 adjusts the balance point for this second bridge. The output is coupled from the primary of T2 to the secondary, then to the base of the first IF amplifier, Q6, through C34 and C35. These two condensers have dissimilar characteristics to provide temperature stability.

Q4 is a common-emitter amplifier, with base bias being provided by R15 and R16. The second and third IF amplifiers, Q5 and Q6 are essentially the same. The output of Q6 drives the limiter into saturation at all times.

These are actual pages from MTI lessons.
LESA 7.3

The
Phase Modulator

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**Lesson 13: The Phase Modulator**

**Introduction**

In the lesson we will study the characteristic of the phase modulator. The phase modulator is a technique of modulating the output of a radio transmission by impressing upon the tuning circuit of the radio receiver a phase-modulated wave, such as the wave produced by a tube-type phase modulator. The tube-type phase modulator is capable of producing a carrier with a phase modulation that is proportional to the input signal. The phase modulator is a more complex device than a simple diode or transistor, although it is capable of producing the necessary waveform for the phase modulator to function properly.

A phase modulator is a device that can convert a carrier wave to a phase-modulated wave. The phase of the carrier wave is altered by the input signal. The phase modulation can be linear or nonlinear. A linear phase modulator produces a linear phase modulation, where the phase of the carrier wave varies linearly with the input signal. A nonlinear phase modulator produces a nonlinear phase modulation, where the phase of the carrier wave varies nonlinearly with the input signal. The phase modulation is usually expressed in terms of the phase deviation, which is the maximum phase deviation of the modulated signal.

**PM versus FM**

In FM, the maximum frequency deviation of the modulated signal depends on the magnitude of the modulating signal, while in PM, the maximum frequency deviation of the modulated signal depends on the maximum value of the input signal. In PM, the frequency of the carrier wave is increased or decreased by the modulating signal, while in FM, the frequency of the carrier wave is increased by the modulating signal.

**PM Modulator**

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**Diagrams and drawings discussed in the text can be folded out flat at the end of the lesson so they are always in front of you while reading through the text — similar to the way this foldout is arranged.**
These Drawings Illustrate Construction Of A Thick-Film IC

These Drawings Illustrate Construction Of A Thick-Film IC

even inductances. Because of their miniature construction, they are limited in their power handling ability and the values of the components. At this point, it is not feasible to include a 500 mF, 400 volt capacitor in an IC. The use of IC's in two-way receivers is constantly increasing.

There are two general classifications for IC's: The monolithic integrated circuit and the thin-film IC. Both types may be combined in one unit, of course. Monolithic means to compose a harmonious whole. Integrated means brought or fitted together, while circuit simply means a path over which electric current flows. Generally, a monolithic integrated circuit is designed to perform some complete function by itself - like an IF amplifier section, audio amplifier section, squelch section, etc.

The thin-film IC is built on a substrate made of some insulating material such as glass or ceramic. The passive components such as resistors, capacitors and the interconnecting "wiring" are deposited on the substrate by evaporation,

A Thin-Film Integrated Circuit

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The MTI course is written for you, the service technician. It was written by authors with decades of actual FM two-way radio experience. The lessons are the size of this booklet, making for easy study. Look inside to see how the convenient foldouts work.
What Our Students Say About Us

IS MORE IMPORTANT THAN

What We Say About Ourselves
I just want to tell you how much I have enjoyed the course. It has helped me tremendously at work as well as we have quite a few Motorola radios.

As you can see, I have taken several correspondence courses. I have found your's to be the best presented. I was actually able to relax while studying your course and looked forward to sitting down and studying my lessons. The material was presented in an easy to follow and easy to understand manner. The promptness with which the lessons were serviced made a very favorable impression. The courtesy of your staff both in correspondence and on the phone was most pleasing.

As advertised, I found your course to be clear, easily understood and full of informative extras.

I would like to take this opportunity to thank you for allowing me to review your newly revised MII course. You have taken a difficult subject and through a thorough knowledge of the subject prepared an outstanding correspondence course in the field of electronics and its application in the field of two-way radio communications.

Your course was a bargain money wise and value wise and I feel fortunate in having the opportunity to gain the information contained in the course.

The course provided just the information that I was seeking.
As an electronics instructor and a recent graduate of your Two-Way Radio Home Study Course, I am impressed by the completeness and practicality of your course and especially the texts.

Having taken your course has been most informative and enjoyable. I would recommend it to anyone interested in FM-Radio.

I have learned more about Diodes and Transistors in these first 3 lessons than I did in two years with Bell and Howell and there I studied Transistors for about 9 months. Thank You.

I recently received my MTI certificate and am proud to display it next to my "first phone" license. The MTI courses certainly deserve more recognition than they get. Having taken several highly regarded correspondence courses, I believe that MTI would have to be classed as the "Rolls-Royce" among them.
An educational institution hired two independent Subject Specialists to review the MTI course. We don’t know who they were, but we did obtain copies of their evaluations.

We are not permitted to tell you who the educational organization is. That’s unfortunate, because you would be even more impressed by the evaluation if you knew.

Turn the page, and read what these specialists said about MTI. Remember, we did not hire them and have never knowingly had any contact with them!
EVALUATION
SPECIALIST #1

- The course covers theory of transistors, FM receivers and transmitters, test equipment, and troubleshooting. It is entirely adequate to meet these objectives.

- The material is up to date and covers modern servicing methods.

- The lessons are professionally written and easily understood. The reading level is correct. The lessons begin with the basic theory of transistors then progress through the various methods of usage and testing.

- The course is well organized. Every sentence is meaningful, there are no superfluous words. The course builds on acquired knowledge.

- There are no teaching devices; however, motivation appears to be adequate, although dependent upon the attitude of the student.

- The illustrations are profuse and to the point. Many are humorous cartoons. They are well chosen and adequate.

- This course combines the best of two worlds in so far as the format is concerned. The lessons are individually bound in small loose-leaf binders. The small size permits study in spare moments, such as commuting, while the loose-leaf feature permits the school to make modifications or up-dating easily.
EVALUATION
SPECIALIST #2

• This is the most complete and authoritative coverage of two-way radio I have ever seen.

• In my opinion, there is nothing as good as this material anywhere.

• The material is outstanding from the standpoint of both technical electronics and home study. It is very specifically addressed to the technician who might not know much mathematics but would not need it anyway. That is, there is no attempt to make nor to teach a PHD.

• I took a great deal of time evaluating this course material and was foiled at every attempt to find something wrong with it. It was frustrating, and at the same time very satisfying.

• Illustrations (some in cartoon form) are excellent and say what is necessary while providing relief from a complex subject. The fold-out circuitry diagrams are convenient to use and very good.

• Again, what could be more functional than conveniently carried small texts with double columns for easy reading? Reference materials are appropriate and supplement the text material very well.
All courses are written for the technician with some previous background in electronics. They are presented in a sequential, step-by-step analysis. This is especially valuable for the technician already employed in the communications industry, as well as for those working in other fields of electronics who desire to enter the communications profession.

The MTI course is different. Math has been eliminated. Instead of studying pure theory, circuits from actual two-way equipment that you might service are analyzed. Each MTI lesson and the related reference texts are clearly written to give you a thorough knowledge of the commercial two-way radio field.

As a prospective student, you must meet at least one of the following requirements:
--FCC license (other than 3rd Class or restricted).
--Previous training in basic electronic theory; at least one year.
--At least two years experience servicing electronic equipment.
--Military electronics training.
--Minimum grade of 60% on MTI Entrance Examination.

If you're not certain that you qualify, ask for an entrance exam. There is no obligation and no salesman will call.

MTI offers this home study program to you as a self-development course, designed for those technicians who want to really know how FM two-way radios operate and how to service them efficiently. If you want to maximize your success in two-way... MTI training is the way!

If we haven't answered all your questions concerning MTI, direct a letter to Mr. Donald R. Wallower, Director.

If all of your questions have been answered... welcome to MTI, the only complete source for FM Two-Way Radio Communications Training.
There is only one 2-WAY RADIO HOME STUDY COURSE exclusively devoted to professional FM radio equipment.