

AMATEUR RADIO HANDBOOK



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INTRODUCTION

1. This booklet is an introductory guide for persons who wish to operate an amateur radio station in Singapore. It contains the examination requirements, operating procedures and licensing conditions. The booklet also contains extracts of the general licence conditions on the Amateur Service prescribed in the Telecommunications (Radio-communication) Regulations.
2. The Amateur Service is a radio-communication service for the purpose of self-training, inter-communication and technical investigations carried out by amateurs, that is, by duly authorised persons interested in radio technique solely with a personal aim and without pecuniary interest.
3. To obtain a Singapore's amateur station licence which authorises him/her to establish and operate a station, the applicant must first satisfy the Info-communications Media Development Authority (hereinafter referred to as "IMDA") that he/she has the necessary qualifications and skills to operate an amateur station without causing any radio interference to other users or radio services.
4. A licence is required for each class of amateur station. IMDA reserves the right to grant or renew any licence under the Telecommunications (Radio-communication) Regulations without assigning any reason therefor.

PART A

GENERAL INFORMATION

1 Radio Amateurs' Examination Schedule

1.1 Frequency and dates of Written Examination

Examination will be held once per quarter on a Saturday of the month from 10.00 am to 1.00 pm. The registration form for the Radio Amateur Examination can be downloaded from IMDA website @ <http://www.imda.gov.sg>.

1.2 Place of Examination: To be determined by IMDA

1.3 Notice of Examination: The schedule of the Radio Amateurs' Examinations is attached together with the application form.

1.4 Examination Requirements: The Written Examination consists of two sections.

1.5 a) Qualifying Grade: The passing marks for each of the two sections is 60%.

Candidate who obtains 60% for Section I will be allowed to apply for the Radio Amateur (Restricted Class) Licence.

A Radio Amateur (Restricted Class) licensee who subsequently wants to apply for the Radio Amateur (General Class) Licence is required to sit and pass Section II of the Radio Amateur Examination.

Candidate who obtains 60% each for Section I and Section II will be allowed to apply for the Radio Amateur (General Class) Licence.

b) Exemptions from Radio Amateurs' Examination: i) City and Guilds of London Institute Radio Amateur Certificate. (Part I only).

ii) Valid Radio-communication Operator's General Certificate of Competency issued by IMDA.

iii) Valid 1st or 2nd Class Radiotelegraph Operator's Certificate of Competency issued by IMDA.

iv) Amateurs who have valid Amateur Radio Licences issued by a competent authority and possess radio amateur qualifications which are acceptable to IMDA¹.

¹ Applicant having foreign amateur licence or qualification which is not in English shall arrange to translate the documents before submitting

v) A recognised degree or its equivalent in Electronics/Communication/Electrical Engineering which covered the subjects contained in Section II of the Radio Amateurs' Written Examination. (Exempted from Section II only).

1.6 Examination Fees:

Type of examination	Fees payable by full-time secondary, pre-university, Institute of Technical Education, and tertiary students in Singapore	Fees payable by all other persons
Written Examination	\$20	\$40

1.7 Purpose of Examination: To qualify candidates for the Amateur Station Licences issued by IMDA.

1.8 Purpose Qualification of Candidates: The examination is open to all candidates, regardless whether or not they have attended a course of tuition. A statement of result will be issued to every candidate who had sat for the examination.

1.9 Class of Licence: i) After passing the Written Examination, the candidate may apply for General Class or Restricted Class Amateur Station Licence.

ii) The Restricted Class licence permits the licensee to operate only on the VHF/UHF band allocated to the Amateur Service. The station shall transmit on F3E or A3E.

iii) The issue of the licence is at the discretion of IMDA and it is not bound to grant an Amateur Station Licence to any applicant and assign any reason therefor.

1.10 Station Licence Fees
 a) General Class: \$100 for 5 years
 b) Restricted Class: \$50 for 5 years

PART B

RADIO AMATEURS' EXAMINATION

1 The Radio Amateurs' Examination Components

1.1 General Information

The Radio Amateurs' Written Examination consists of two sections:

- Section I: Licensing conditions, operating procedures and practices and transmitter interference;
- Section II: Elementary theory of electricity, radio communication and transmitting techniques.

Applicant can download the registration form for the Radio Amateur Examination from the IMDA website @ <http://www.imda.gov.sg>.

The fee for the examination must be enclosed with the application.

The fee will not be refunded to any candidate who withdraws from, or fails to attend the examination, nor can it be transferred from one examination to another at a later date.

IMDA has removed the Morse code requirement for HF amateur radio operations with effect from 15 September 2003. As such, the Practical Examination on Morse code is no longer required for new applicants for Amateur Station (General Class) Licence.

The Written Examination is conducted by Singapore Amateur Radio Transmitting Society (SARTS) on behalf of IMDA.

1.2 Statement of Results

IMDA will send a statement of the result to every candidate who has sat for the Radio Amateurs' Written Examination.

PART C

DETAILS OF RADIO AMATEURS' EXAMINATION SYLLABUS AND OBJECTIVES

The Written Examination consisting of two sections. Section I contains 35 multiple-choice questions and the time allocated is 1 hour. Section II contains 60 multiple-choice questions and the time allocated is 1 hour 45 minutes. There will be an interval of 15 minutes between the two sections.

WRITTEN PAPER

SECTION I - Licensing Conditions Operating Practices and Transmitter Interference

1 Licensing Conditions - Examination Objectives

- 1.1 State the qualification required of the holder of Amateur Station Licence.
- 1.2 State accurately the conditions of the Amateur Station Licence with regard to:-
 - a) period of validity, renewal, revocation, variation and return;
 - b) places in which the station may be established and used;
 - c) purposes for which the station may be used and persons who may use it;
 - d) frequency bands, powers and classes of emission which may be used;
 - e) requirements relating to avoidance of interference, restriction of bandwidth, limitation of harmonic and spurious emissions and checking of transmitter performance;
 - f) use of call-signs, log-keeping, inspection and closing down of the station; and
 - g) limitations and prohibitions in connection with the use of the station.

SYLLABUS

- (1) Conditions (terms, provisions and limitations) laid down by IMDA for the Amateur Station Licence;
- (2) The purposes for which the transmitters may be used, types of signals permissible, classes of emission, powers, frequency bands, frequency control and measurements;
- (3) Avoidance of interference to other stations particularly in frequency bands shared with other services;

- (4) Types of licence and qualifications required of holders of amateur station; and
- (5) Use of call signs.

2 Operating Practices and Procedures - Examination Objectives

- 2.1 Describe calling procedures in telegraphy and telephony;
- 2.2 Demonstrate knowledge of maintaining a log;
- 2.3 For satellites and repeaters:
 - a) explain why they are used in the Amateur Service; and
 - b) describe the method of accessing a repeater.
- 2.4 Explain the reasons for using Q-codes and other abbreviations;
- 2.5 Demonstrate knowledge of the phonetic alphabet and explain why it is used;
- 2.6 For safety in operating:
 - a) explain why capacitors should be discharged; and
 - b) explain why equipment to be repaired should be disconnected from the mains.

SYLLABUS

- (1) Calling procedures in telegraphy and telephony: general calls to all stations and calls to specific stations;
- (2) Log keeping;
- (3) Use of satellites and repeaters: accessing a repeater;
- (4) Use of Q-codes and other abbreviations in Amateur Service;
- (5) The phonetic alphabet: reasons for its use; and
- (6) Safety in the amateur station, discharging of capacitors and mains disconnection.

3 Transmitter Interference - Examination Objectives

- 3.1 Describe the consequences of poor frequency stability;

- 3.2 For spurious emissions:
- a) describe their causes;
 - b) describe methods, appropriate to the Amateur Service, of detecting and recognising their presence; and
 - c) describe, in practical terms, the measures which should be taken in both the design and construction of transmitters and the use of filters, to minimize them.
- 3.3 State the causes of mains-borne interference and describe methods of suppression;
- 3.4 Describe simple means of limiting the audio bandwidth of emissions and explain why this is necessary;
- 3.5 Demonstrate knowledge of frequency-checking equipment.

SYLLABUS

- (1) Frequency stability; consequences of poor frequency stability; risks of interference; out-of-band radiation; difficulties in communication;
- (2) Spurious emissions, causes and methods of prevention; harmonics of the radiated frequency; direct radiation from frequency determining and frequency changing stages of a transmitter; parasitic oscillations; key clicks; excessive sidebands due to over-modulation;
- (3) Mains-borne interference; causes and methods of suppression;
- (4) Audio-bandwidth limitations; limitation and methods; and
- (5) Frequency checking.

SECTION II - Electrical, Electronics and Radio-communications Theory

1 Electrical Theory - Examination Objectives

- 1.1 For basic terms and units:-
- a) define the terms; and
 - b) state the SI units for given measurements and define their relationship to each other;
- 1.2 For current, power and resistance:

- a) state Ohm's Law and use it to solve simple problems;
 - b) calculate total current in series and parallel circuits;
 - c) calculate power in a dc circuit;
 - d) calculate combined resistance of resistors in series and parallel circuits;
 - e) describe the function of resistors in electronic circuits;
 - f) determine the type of resistor most suitable for given application; and
 - g) state the magnetic and heating effects of currents and their applications.
- 1.3 For inductance and capacitance:
- a) explain what is meant by inductive reactance, capacitive reactance and impedance;
 - b) explain their effects in ac circuits;
 - c) define the units;
 - d) calculate total inductance in series circuits;
 - e) calculate total capacitance in series and parallel circuits;
 - f) state the factors which affect the value of the capacitance of a capacitor; and
 - g) solve simple problems on given ac series circuits.
- 1.4 Define the terms describing the sine wave;
- 1.5 Explain simply the terms relating to power, reactance, impedance and resonance;
- 1.6 For transformers and tuned circuits;
- a) explain the function and describe the operation of a transformer,
 - b) identify series and parallel ac circuits and calculate resonant frequency from given data;
 - c) explain voltage amplification and current amplification effects; and
 - d) state the conditions under which oscillations may be maintained.

SYLLABUS

- (1) Basic electrical terms, their meaning and use: emf, current, conductor, resistance, insulator, power, series circuit, parallel circuit;
- (2) SI units, their use and relationship to each other: volt, coulomb, ampere, ohm, watt, hertz;
- (3) Current, power and resistance; Ohm's Law. Total current and combined resistance in series and parallel circuits. Resistors, types and applications; resistors in electronic circuits. Power in a dc circuit. Magnetic and heating effects of currents: applications;
- (4) Inductance and capacitance; appropriate units; effects in ac circuits. Total inductance and capacitance in circuits. Meaning of inductive and capacitive reactance. Factors affecting capacitance value;
- (5) The sine wave. Definition of terms: amplitude, period and frequency; instantaneous, peak, peak-to-peak, RMS and average values;
- (6) Power, reactance, impedance and resonance in ac circuits; simple explanation of terms: phase angle, phase difference, phase lead and lag; reactance, impedance, series resonance, parallel resonance, resonant frequency and Q (magnification) factor; and
- (7) Transformers: function and operation. Tuned circuits: series and parallel ac circuits, resonant frequency data and calculations; voltage amplification and current amplification effects. Maintenance of oscillations in tuned circuits.

2 Semiconductors - Examination Objectives

- 2.1 Explain in simple terms the principles of:
 - a) operation of npn and pnp semiconductor devices;
 - b) diode rectification; and
 - c) control of output current and voltage when transistors are used as audio-frequency and radio-frequency amplifiers.
- 2.2 Describe the operation of given devices in radio equipment;
- 2.3 Describe and explain the principles of operation of typical power supply circuits with smoothing and voltage stabilisation systems.

SYLLABUS

- (1) Characteristics and principles of operation of npn and pnp semiconductor devices; principles of diode rectification; control of output current and voltage when transistors are used as audio-frequency and radio-frequency amplifiers;
- (2) Use of semiconductor devices in radio equipment as:
 - a) oscillators (crystal and variable-frequency types);
 - b) amplifiers (audio-frequency and radio-frequency types);
 - c) frequency changers;
 - d) frequency multipliers;
 - e) demodulators; and
 - f) signal detectors.
- (3) Typical power-supply circuits: power rectification; smoothing and voltage stabilisation systems.

3 Radio Receivers - Examination Objectives

- 3.1 Explain the principles of reception of given signals;
- 3.2 State the advantages and disadvantages of high and low intermediate frequencies;
- 3.3 Explain adjacent-channel and image-frequency interference and the methods of minimizing them;
- 3.4 Explain the general principles of frequency modulation and demodulation;
- 3.5 Describe the use of a beat-frequency oscillator for the reception of type A1 signals;
- 3.6 Explain the characteristics of a single-sideband signal;
- 3.7 Describe the purpose of a carrier re-insertion oscillator.

SYLLABUS

- (1) Principles of reception of continuous-wave, double-sideband, single-sideband and frequency-modulated signals in terms of radio-frequency amplification, frequency changing (where appropriate), demodulation or detection and audio amplification. The superheterodyne principle of reception;

- (2) Advantages and disadvantages of high and low intermediate frequencies; adjacent-channel and image-frequency interference and its control;
- (3) Frequency modulation and demodulation; and
- (4) Typical receivers; use of a beat-frequency oscillator. Characteristics of a single-sideband signal and the purpose of a carrier re-insertion oscillator.

4 Transmitters - Examination Objectives

4.1 For oscillators:

- a) describe their construction; and
- b) state the factors affecting their stability.

4.2 Describe the operation of given stages in transmitters.

4.3 For methods of key:

- a) describe and explain the methods; and
- b) state the advantages and disadvantages of each.

4.4 For modulation and types of emission:

- a) describe and explain the principles of modulation of radio-frequency emissions in given modes; and
- b) state the relative advantages of given modes.

SYLLABUS

- (1) Oscillators used in transmitters; stability of variable-frequency and crystal-controlled oscillators; their construction and factors affecting stability;
- (2) Transmitter stages: operation of frequency changers, frequency multipliers, high and low-power amplifiers and power output amplifiers (including linear types);
- (3) Methods of keying transmitters for telegraphy; advantages and disadvantages; and
- (4) Methods of modulation and types of emission in current use including single-sideband and frequency modulation; emissions in the A2A, A2B, A3E, J3E, F2A, F2B, F3E, G3E modes; relative advantages.

5 Propagation and Aerials - Examination Objectives

5.1 Explain given basic terms;

5.2 For electromagnetic waves:

- a) explain their generation; and
- b) state the relationship between electric and magnetic components.

5.3 For the ionosphere, troposphere and upper atmosphere;

- a) describe in simple terms the structure of the ionosphere;
- b) explain in simple terms, the refracting and reflecting properties of the ionosphere and the troposphere;
- c) explain how given factors affect the ionization of the upper atmosphere; and
- d) state the effect of varying degrees of ionization of the upper atmosphere on the propagation of electromagnetic waves.

5.4 Describe in simple terms given forms of propagation;

5.5 Explain fade-out and given forms of fading;

5.6 For radio waves:

- a) state their velocity in free space;
- b) state the relationship between velocity, frequency and wavelength; and
- c) calculate frequency and wavelength from given data.

5.7 For aerials and transmission lines:

- a) describe and explain their operation and construction;
- b) describe balanced and unbalanced feeders and explain the principles of propagation of radio waves along transmission lines;
- c) explain the principles of coupling and matching aerials to transmitters and receivers; and
- d) identify from diagrams typical coupling and matching arrangements.

SYLLABUS

- (1) Explanation of basic terms: ionosphere, troposphere, atmosphere, field strength, polarization, maximum usable frequency, critical frequency, skip distance;
- (2) Generation of electromagnetic waves: relationship between electric and magnetic components;
- (3) Structure of the ionosphere. Refracting and reflecting properties of the ionosphere and troposphere. Effect of sunspot cycle, winter and summer seasons and day and night on the ionization of the upper atmosphere, effect of variations of ionization on the propagation of electromagnetic waves;
- (4) Ground wave, ionospheric and tropospheric propagation;
- (5) Fade-out and types of fading: selective, interference, polarization, absorption and skip;
- (6) Velocity of radio waves in free space: relationship between velocity of propagation, frequency and wavelength: calculation of frequency and wavelength;
- (7) Receiving and transmitting aerials; operation and construction of typical aerials including multiband and directional types; their directional properties. Coupling and matching; and
- (8) Transmission lines; balanced and unbalanced feeders; elementary principles of propagation of radio waves along transmission lines: velocity and standing waves.

6 Measurement - Examination Objectives

6.1 For given instruments:

- a) state the purposes for which they are used;
- b) state the relative accuracy; and
- c) describe in detail their use at an amateur transmitting station.

6.2 Describe the construction of dummy loads and explain their use;

6.3 Explain the purpose and method of using a standing-wave ratio meter;

6.4 For power input and output measurement:

- a) explain in detail how the dc power input to the final amplifier of a transmitter is measured;

- b) describe the incorporation of metering arrangements in an amateur's transmitter;
- c) state the types of meter required for the measurement of dc, ac and radio-frequency voltages and current; and
- d) explain the method of measurement of radio-frequency power output of linear amplifiers.

6.5 Describe in detail the method of using an oscilloscope to display a waveform.

SYLLABUS

- (1) Purposes, operation and use of absorption wavemeters, heterodyne wavemeters and frequency counters; relative accuracies;
- (2) Dummy loads, their construction and use in tuning transmitters;
- (3) Use of standing-wave ratio meters;
- (4) Measurement of:
 - a) dc power input to the final amplifier of a transmitter;
 - b) rf power output of linear power amplifiers; and
 - c) current at radio frequencies.
- (5) Setting up and use of a cathode-ray oscilloscope to examine and measure waveforms and to monitor the depth of modulation.

PART D

THE AMATEUR STATION LICENCE

1 APPLICATION FOR AMATEUR STATION LICENCE

1.1 General Information

IMDA may issue Amateur Station Licences to qualified persons interested in the operation of radio transmitting and receiving equipment and the furtherance of radio-communication techniques in general.

Every applicant for an Amateur Station Licence must have passed the Radio Amateurs' Examination or holds an amateur's qualification which is acceptable to the IMDA.

IMDA may refuse to issue an Amateur Station Licence to any applicant, even though he may have satisfied the examination requirements or possess the necessary qualifications, without assigning any reason therefor.

1.2 Details of Application

When the applicant has attained the required qualifications he should submit online the application for Amateur Station Licence through <https://www.gobusiness.gov.sg/licences>, with the following documents: -

- a) citizenship status
- b) statement of results of the Radio Amateurs' Written Examination (or other amateur's qualifications);
- c) if you have a radio amateur certificate issued by a competent authority, a photocopy of the certificate; and
- d) if you hold a valid radio amateur station licence issued by a competent authority, a photocopy of your current radio amateur licence.

The applicant is advised not to proceed with the purchase of the equipment or installation of the station until his application for a licence has been approved. All radio amateur equipment to be used in a licensed amateur station must be approved by IMDA.

1.3 Licence Fee

The frequency and licence fees are specified in the Telecommunications (Radio-communication) Regulations. The fee payable under these Regulations shall be paid in advance. The licence valid for 5 years and is renewable on a 5 yearly basis and the fee must be paid before the anniversary of the issue date of the licence. IMDA has waived the frequency application and processing fees and the annual frequency usage fees.

1.4 Conditions on the issue of Amateur Station Licence

To qualify for a licence, the applicant must

- a) be over 21 years of age; where the applicant is under the age of 21 years but above the age of 16 years, his application for licence must be counter-signed by the applicant's parent, guardian or by any other person approved by IMDA, and who shall be responsible for the observance of the conditions of the licence;
- b) have passed the Radio Amateurs' Written Examination or possess a radio amateur qualification which is acceptable to IMDA and a valid radio amateur licence issued by a competent authority; and
- c) the radio amateur equipment is of a model that is approved by IMDA.

PART E

RULES AND CONDITIONS GOVERNING THE OPERATION OF AN AMATEUR RADIO STATION

1 The Telecommunications (Radio-communication) Regulations

The licensee shall observe and comply with the relevant provisions of the Telecommunications (Radio-communication) Regulations and any amendments made thereof.

2 International Requirement

The licensee shall observe and comply with the relevant provisions of the Radio Regulations of the International Telecommunication Convention.

3 Display of Licence

The amateur station licence shall be displayed, in close proximity of the equipment, at the station's licensed address.

4 Frequency Bands and Classes of Emission

The transmitting frequency bands allowed of an amateur radio station shall be at the discretion of IMDA but within the limits prescribed by the Radio Regulations, annexed to International Telecommunication Convention of the International Telecommunication Union. IMDA has waived the frequency application and processing fees and the annual fees for use of a frequency in operating an amateur radio station.

5 Transmitting Power

Appendix 1 shows the frequency bands that are available for allocation to amateur working with the power output and classes of emission allowed in each band.

The maximum power allowed (measured as the direct current power input to the anode circuit of the final stage) of an amateur transmitter shall be at the discretion of IMDA and shall be specified in the licence. In no case shall the power of the transmitter exceed 300 watts (DC input), provided that it does not cause radio frequency interference to other licensed or authorised stations or networks or telecommunication installation or equipment which may be lawfully owned, used or operated by any other person.

The maximum RF output power allowed for the Restricted Class Station Licence is 10 watts (erp).

6 Restriction on New Licence Holder

When a licence is issued to an amateur for the first time, IMDA may restrict the licensee to the use of continuous wave (A1A, A1B) emissions for the first twelve months. However, IMDA may, in its discretion, permit any applicant who produces proof of a valid licence held elsewhere (which is acceptable to IMDA) to operate as if he had held a licence for one year in Singapore.

7 Operational Conditions

A licensee shall observe the following conditions: -

- a) the licensed station shall only be operated at locations approved by IMDA and as shown in the licence;
- b) the station shall in all cases be operated by the licensee or by other licensed amateurs in the presence of the licensee, or, in the case of a training institution, by members of such institution in the presence of the licensee. The licensee will at all times be responsible for the proper operations of the station;
- c) the tuning of the transmitter shall be accomplished by methods which ensure a high degree of accuracy and all emissions shall be maintained within the authorised bands so that no appreciable energy is radiated on any frequency outside the limits of the authorised bands;
- d) a satisfactory method of frequency stabilisation shall be employed in the sending equipment comprised in the station. Equipment shall be provided capable of verifying that the sending equipment comprised in the station is operating with emissions within the authorised bands;
- e) the station shall always be equipped with receiving as well as transmitting equipment;
- f) all equipment used or intended to be used by the licensee shall be erected, fixed, placed and used, so as not to interfere with the efficient and convenient working of other authorised stations;
- g) the licensee shall seek the approval of IMDA in writing of any change of equipment, antenna installation, location and address of the licensee; and
- h) the licensee shall be identified by the transmission of a call sign assigned to him by IMDA at the beginning and end of each period of transmission.

8 Separate Broadcast Receiver Licence Required

Every licensee shall, in respect of his amateur station take out a separate licence for a broadcast sound receiver, except where the receiving equipment of the station is such that it cannot be used for the reception of broadcast matters.

9 Transmission, Procedure & Limitation

- a) The station may be operated at any time provided that no period of uninterrupted transmission shall exceed ten minutes.
- b) Messages may be exchanged with other licensed amateur stations except where the Government has prohibited communication of this nature.
- c) Messages shall be sent in plain language and shall relate solely to the licensee's experiments or to the licensee's personal affairs (not being business affairs or transactions) or to such personal affairs of the person with whom the licensee is communicating. The station shall not be used for sending news, advertisement, communications of a business or non-experimental character, messages for pecuniary reward, or messages for or on behalf of a third party.
- d) No message which is grossly offensive or of an indecent or obscene character shall be sent.
- e) Before making any call or test transmission, the frequency on which it is proposed to transmit should be monitored to ensure the transmission will not cause interference to other stations.
- f) In calling another station, the call-sign of that stations shall be sent at least three times but not more than eight times after which the signal `de' for `from' shall be sent once and the call-sign of the calling station three times. When a station called does not reply to a call sent three times at intervals of two minutes, the calling shall cease and may not be resumed until after an interval fifteen minutes.
- g) In answering a call, the call-sign of the calling station shall be sent three times, the signal `de' once and the call-sign of the answering station three times. and
- h) The licensee shall use the accepted practice of transmitting messages and shall be conversant with the accepted international Q codes.

10 Station Call-Sign

The station's call-sign may be altered at any time by IMDA by notice in writing. It must be sent for identification purpose at the beginning and end of each period of transmission. The prefix for Singapore licensed stations is '9V' and shall always be included in the call-sign.

11 Radiotelephony Operation

When telephony is used, the letters of the call-sign and in cases where it is necessary to spell out words or figures, the international accepted Phonetic Alphabet and Figure Code as shown in Appendix 2 should be used. Words used in this manner shall not be capable of any undesirable or improper interpretation.

12 Station Log-Book

An indelible record shall be kept in a log-book, serially numbered (not loose-leaf) showing the following: -

- a)
 - i) date and time of commencement and ending of every call made from the station;
 - ii) call-signs of the stations from which messages addressed to the station are received or to which messages are sent;
 - iii) time (local or GMT) of the commencement and termination of radio traffic;
 - iv) test transmissions of the station;
 - v) frequency band(s) and class or classes of emission in each case;
 - vi) no gaps shall be left between entries and all entries shall be made at the time of sending and receiving; and
 - vii) the record shall in all cases be signed at the time of recording by the licensee.
- b) Every such log-book shall be preserved by the licensee for a period of 2 years so that at any time full particulars of sending periods in the preceding calendar years are available for examination.
- c) The log-book shall be available for examination at all reasonable times by an authorised officer of IMDA.

13 Inspection of Station

The licensee of an amateur station shall at any reasonable time permits an authorised officer of IMDA to inspect and test the station equipment.

14 Avoidance of Interference

- a) The equipment comprised in the station shall be so designed, constructed, maintained and used that the operation of the station does not cause any harmful interference to other authorised radio services or stations.
- b) In the case of interference, the licensee shall take all possible steps to eliminate the source of such interference.
- c) At all times, every precaution shall be taken to avoid over-modulation, and to keep the radiated energy within the narrowest possible frequency bands having regard for the class of emission in use. In particular, the radiation of harmonics and spurious emissions shall be suppressed to such a level that they shall minimise interference with authorised radio services or stations.
- d) To ensure that the above requirements are met, tests shall be made from time to time and details of those tests shall be recorded in the station log-book.
- e) Adjustment of an amateur station shall, in general, be made by using a dummy load.

15 Licensee's Station Used by IMDA

- a) Except with the written permission of IMDA, no licensee shall call or transmit to any station other than a licensed amateur station.
- b) IMDA may, in exceptional circumstances, require a licensee to transmit by means of his station any message that is in not in contravention of the provisions of the Telecommunications Act (Cap 323), or any Regulations made thereunder and the licensee shall comply with such request.

16 Mobile/Portable Station

IMDA may grant approval to the holder of a General or Restricted Class Amateur Licence to establish a station as a mobile or portable station subjecting to such conditions as it shall deem fit which shall include the following: -

- a) The mobile or portable station shall only operate in the frequency bands approved by IMDA and shall only be allowed to operate in Singapore.
- b) The mobile or portable station and the general station for which a licence has been issued shall not be operated simultaneously.

- c) When established as a mobile or portable station, the call-sign shall be the call sign allotted to the general station followed by `/M' or `/P' and the transmitter output power of the portable station shall not exceed 10 watts (erp).
- d) The licence to establish a mobile or portable station may be modified or revoked at any time by IMDA without assigning any reason therefor.
- e) The station is said to be operating as a mobile or portable station when it is readily movable from place to place to be operated therefrom.

If radio amateur has been licensed to operate on fixed amateur radio station, the mobile or portable station can be licensed as part of the existing fixed amateur radio station set up and the station fee of \$50.00 per mobile/portable station is waived. The station fee for the mobile or portable station is however payable if such station is the only station operated by the radio amateur.

17 Station to Close Down

The station shall be closed down at any time on the demand of an authorised officer acting under the authority of IMDA.

18 Period of Licence, Renewal, Revocation and Variation

- a) The licence shall continue in force for one year from the date of issue, and thereafter so long as the licensee pays to IMDA in advance each year on or before the expiry of the current licence, the renewal fees prescribed in the Telecommunications (Radio-communication) Regulations. IMDA may at anytime vary all or any of the conditions upon which a licence is granted or impose additional conditions and a licensee shall, at his own expense, comply with the varied or additional conditions.
- b) IMDA may refuse to renew a licence without assigning any reason therefor.
- c) The licence is not transferable except with the consent in writing of IMDA.

**TABLE 1
FREQUENCY BANDS, POWER AND CLASSES OF EMISSIONS**

Footnote No.	Frequency Bands (in MHz)	Classes of Emission	POWER	
			Maximum DC Input Power	Radio Frequency Output Peak Envelope Power for A1, A2 and A3 Emissions only (See Note C)
2 & 5	1.8 - 2.0	A1A, A1B, A2A, A2B, A3E, R3E, H3E, J3E, F1A, F1B, F2A, F2B, F3E and G3E	10 watts	26.67 watts
2	3.5 - 3.9		300 ² watts	800 watts
3	7 - 7.10 7.1 - 7.2 10.1 - 10.15 14.0 - 14.35 18.068 - 18.168 21.0 - 21.45 24.890 - 24.990			

² The maximum output power with 2/3 efficiency will be 200 watts with DC Input power of 300 watts.

	28.0 - 29.7			
6 & 8	144 – 146		-	25 watts
6 & 7	430 – 440		-	See Appendix 2
1,2,4 & 6	1,240 - 1,300			Subject to licensing conditions
1,2,4 & 6	2,400 - 2,450			
1,2,4 & 6	5,650 - 5,850			
1,2,4 & 6	10,000 - 10,500			
6	24,000 - 24,050			
1,2,4 & 6	24,050 - 24,250			
1,2,4 & 6	5,700 - 5,800	K1A, K2A, L2A, K2E and L3E	-	As above
1,2,4 & 6	10,050 - 10,450			

FOOTNOTES

1. These bands allocated to stations in the Amateur Service on a secondary basis and are used on condition that they do not cause interference to other radio services.
 2. These bands are shared by other services.
 3. This band 10.1 - 10.15 is allocated in the Amateur Service on secondary basis.
 4. Only certain spot frequencies within these bands are allocated for use by radio amateurs and these spot frequencies can be obtained on written application.
 5. The type of transmission known as Radio Teleprinter (RTTY) may not be used in this band.
 6. Use of any frequency in these bands shall be only with the prior written consent of the IMDA and it shall indicate the power and conditions under which the station may transmit, taking into consideration the operational characteristics of the station.
 7. The spot frequencies allocated within these bands are shown in Appendix 2 and shall be used only with the prior written consent of the IMDA.
 8. CW operators to use the low end of the band; and other permitted classes of emission to use the mid and upper portion of the band.
- A The symbols used to designate the classes of emission have the meanings assigned to them in the International Telecommunication Convention. They are :-

Amplitude Modulation

- A1A Morse telegraphy without the use of modulating audio frequency
- A1B Teletype telegraphy without the use of modulating audio frequency
- A2A Morse telegraphy with the use of modulating audio frequency
- A2B Teletype telegraphy with the use of modulating audio frequency
- A3E Telephony, double-sideband
- R3E Telephony, single-sideband, reduced carrier
- H3E Telephony, single-sideband, full carrier
- J3E Telephony, single-sideband, suppressed carrier

Frequency (or phase) Modulation

- F1A Morse telegraphy by frequency-shift keying without modulating audio frequency
- F1B Teletype telegraphy by frequency-shift keying without modulating audio frequency
- F2A Morse telegraphy by on-off keying of frequency-modulating audio frequency
- F2B Teletype telegraphy by on-off keying of frequency-modulating audio frequency
- F3E Telephony by frequency modulation
- G3E Telephony by phase modulation

Pulse Modulation

- K1A Telegraphy by on-off keying of a pulse carrier without the use of a modulating audio frequency.
- K2A Telegraphy by on-off keying of a modulating audio frequency or frequencies or by on-off keying of a modulated pulse carrier - the audio frequency or frequencies modulating the amplitude of the pulses.
- L2A Telegraphy by on-off keying of a modulating audio frequency or frequencies or by on-off keying of a modulated pulsed carrier - the audio frequency or frequencies modulating the width (or duration) of the pulses.

- K2E Telephony, amplitude modulated pulses.
- L3E Telephony, width (or duration) modulated pulses.
- B DC input power is the total direct current power input to (i) the anode circuit of the valves(s) or (ii) any other device energising the aerial.
- C As an alternative, for R3E and J3E single-sideband types of emission the power shall be determined by the peak envelope power (PEP) under linear operation. The radio frequency output peak envelope power under linear operation shall be limited to 2.667 times the DC input power appropriate to the frequency band concerned. This column gives the maximum power determined by this method which may be used.
- D Double-sideband suppressed carrier emissions are permitted within the terms of this licence.

**BAND PLAN AND SPOT FREQUENCIES FOR UHF AMATEUR BAND
430 - 440MHz (on secondary basis)**

	<u>BAND</u>	<u>MODE</u>	<u>FREQUENCIES (MHz)</u>	<u>MAXIMUM OUTPUT POWER</u>
1	432.000 - 432.150	Continuous Wave (CW) only	432.000	10 watts erp
2	432.150 - 432.500	Single-Sideband (SSB) and CW only	432.200	- do -
3	432.500 - 432.800	Radio Teleprinter (RTTY) Facsimile (FAX)	432.600	- do -
4	433.375 - 434.600	FM Simplex Channels	433.625 433.650	- do -

PHONETIC ALPHABET AND FIGURE CODE

When it is necessary to spell out call-signs, service abbreviations, words and figures the following tables are suggested to be used:-

Letter Spelling Table

Letter to be transmitted	Word to be used	Spoken as*
A	Alfa	<u>AL</u> FAH
B	Bravo	<u>BRAH</u> VOH
C	Charlie	<u>CHAR</u> LEE or <u>SHAR</u> LEE
D	Delta	<u>DELL</u> TAH
E	Echo	<u>ECK</u> OH
F	Foxtrot	<u>FOKS</u> TROT
G	Golf	GOLF
H	Hotel	HOH <u>TELL</u>
I	India	<u>IN</u> DEEAH
J	Juliet	<u>JEW</u> LEE <u>ETT</u>
K	Kilo	<u>KEY</u> LOH
L	Lima	<u>LEE</u> MAH
M	Mike	MIKE
N	November	NO VEM BER
O	Oscar	<u>OSS</u> CAH
P	Papa	PAH <u>PAH</u>
Q	Quebec	KEH <u>BECK</u>
R	Romeo	<u>ROW</u> ME OH
S	Sierra	SEE <u>AIR</u> RAH
T	Tango	<u>TANG</u> GO
U	Uniform	<u>YOU</u> NEE FORM or <u>OO</u> NEE FORM
V	Victor	<u>VIK</u> TAH
W	Whisky	<u>WISS</u> KEY
X	X-ray	<u>ECKS</u> RAY
Y	Yangkee	<u>YAN</u> KEE
Z	Zulu	<u>ZOO</u> LOO

THE INTERNATIONAL Q-CODE

Below are some of the International Q-Codes which are commonly used in the Amateur Service:

QRG ? : Will you tell me my exact frequency?
Your exact frequency iskHz.

QRH ? : Does my frequency vary?
Your frequency varies.

QRI ? : What is the tone of my transmission?
The tone of your transmission is(a) good, (b) variable, (c) bad.

QRK ? : What is the intelligibility of my signals?
The intelligibility of your signals is(a) bad, (b) poor, (c) fair, (d) good,
(e) excellent.

QRL ? : Are you busy?
I am busy. Please do not interfere.

QRM ? : Is my transmission being interfered with?
Your transmission is being interfered with(a) nil, (b) slightly, (c) moderately,
(d) severely, (e) extremely.

QRN ? : Are you troubled by static?
I am troubled by static(a) nil, (b) slightly, (c) moderately, (d) severely,
(e) extremely.

QRO ? : Shall I increase transmitter power?
Increase transmitter power.

QRP ? : Shall I decrease transmitter power?
Decrease transmitter power.

QRQ ? : Shall I send faster?
Send faster (.....words per minute).

QRS ? : Shall I send slowly?
Send more slowly (..... words per minute).

QRT ? : Shall I stop sending?
Stop sending.

- QRU ? : Have you anything for me?
I have nothing for you.
- QRV ? : Are you ready?
I am ready.
- QRX ? : When will you call me again?
I will call you again athours onkHz.
- QRZ ? : Who is calling me?
You are being called by onkHz.
- QSA ? : What is the strength of my signals?
The strength of your signals is(a) scarcely perceptible, (b) weak, (c) fairly good, (d) good, (e) very good.
- QSB ? : Are my signals fading?
Your signals are fading.
- QSD ? : Are my signals mutilated?
Your signals are mutilated.
- QSL ? : Can you acknowledge receipt?
I am acknowledging receipt.
- QSO ? : Can you communicate withdirect?
I can communication withdirect.
- QSP ? : Will you relay to
I will relay to
- QSV ? : Shall I send a series of V's for adjustment on this frequency?
Send a series of V's.
- QSZ ? : Shall I send each word or group more than once?
Send each word or group twice.
- QTH ? : What is your location?
My location is
- QTR ? : What is the correct time?
The correct time ishours.

FREQUENCY-CHECKING EQUIPMENT IN AMATEUR STATIONS

The following notes may be helpful as a guide.

1. A licensee must:-
 - (a) be able to verify that his transmissions are within the authorised frequency band (i.e. that no appreciable energy is radiated outside the band).
 - (b) use a satisfactory method of frequency control.
 - (c) ensure that his transmissions do not contain unwanted frequencies (i.e. harmonics and spurious frequencies).
2. When his station is inspected by an authorised officer of IMDA, the licensee will be expected to demonstrate that he can conform with the requirements (a) to (c) above.
3. As a general rule, a station requires a crystal reference source to comply with 1(a) and (b) above so that:-
 - (a) with a crystal-controlled transmitter an absorption device of suitable frequency range and accuracy is necessary to check that the desired harmonic of the crystal frequency is selected.
 - (b) with a transmitter that is not crystal-controlled a wavemeter based on a crystal oscillator is necessary.

Within these outline requirements the licensee is free to decide how he will meet the licence regulations. IMDA cannot, of course endorse or recommend particular makes or types of equipment, and will assess the suitability of what the licensee proposes to use from the details he gives in his licence application.

4. The following comments may provide useful guidance:-
 - (a) Frequency measuring equipment should be of sufficient accuracy to verify that emissions are within the authorised frequency bands. For example, operation in the centre of the 21.0 - 21.45 MHz band would require frequency measurement to an accuracy of $\pm 1.0\%$ to ensure that emissions were within band, whereas operation within, say, 10 kHz of band-edge would require measurement to an accuracy of $\pm 0.05\%$. When determining the proximity of an emission to band-edge, the bandwidth

due to modulation, on the appropriate side of the carrier, needs to be added to the frequency tolerance of the carrier.

- (b) Heterodyne wavemeters and crystal calibrators. When used in conjunction with a general coverage receiver, a 100 kHz crystal is usually adequate for checking frequencies up to 4 MHz. For higher frequencies the spacing between 100 kHz marker points is too small for accuracy, and a crystal of 500 kHz, or preferably 1 MHz, should be used in addition. If the receiver covers only the Amateur frequency bands the bandspread scale will usually allow a 100 kHz crystal to be used with sufficient accuracy throughout the h.f. bands.
- (c) Absorption wavemeters and similar devices. The scale length and accuracy should be suitable for measurements of the required accuracy to be made, and the frequency coverage must extend up to the second, and preferably the third harmonic of the radiated frequency so that the presence of unwanted frequencies may be detected. For v.h.f. and u.h.f. transmitters, probably the best technique is to measure the frequency of the fundamental oscillator as accurately as possible and to use an absorption device to confirm that the wanted harmonic has been selected. When a v.h.f. or u.h.f. converter is used in conjunction with a h.f. receiver and the calibration of the main receiver can be checked with sufficient accuracy, this will provide a means of frequency measurement but it is also advisable to use an absorption wavemeter to check the measurement and to confirm that no unwanted radiations are present.

STUDY GUIDES

The following publications are suggested for the guidance of candidates preparing for the Radio Amateurs' Examination and may be obtained direct from the publishers or from book stores.

- 1) 'The Radio Amateur's Licensing Handbook' obtainable from the IMDA website @<http://www.imda.gov.sg>.

- 2) Radio Society of Great Britain Publications (RSGB):
 - 'A Guide to Amateur Radio'

 - 'The Radio Amateur's Examination Manual'

 - 'Radio Communication Handbook'

 - 'Amateur Radio Techniques'

 - 'Amateur Radio Operating Manual'

- 3) American Radio Relay League (ARRL) publications:
 - 'Radio Amateur Handbook'

 - 'Course in Radio Fundamentals'

 - 'Single-Sideband For The Radio Amateurs'

 - 'Understanding Amateur Radio'

 - 'Ham Radio Operating Guide'

The above publications are available from the RSGB Publications (Sales), Lambda House, Cranborne Road, Potters Bar, Herts, UK EN6 3JE. Website address @ <http://www.rsgb.org>.

- 4) Other publications:
 - 'Radio & Line Transmission, Volumes I, II and III by Danielson & Walker'

 - 'Ham Radio - A Beginner's Guide' by R H Warring'

 - 'Understanding Radio Electronics' by Milton Kaufman'

PART F

SINGAPORE AMATEUR RADIO TRANSMITTING SOCIETY ("SARTS")

(Contributed by SARTS)

1 SARTS is a society comprising licensed amateur radio operators in Singapore and others who are interested in the hobby of amateur radio. The Society provides an opportunity for those interested in the hobby to meet together to share matters of common interest so as to derive greater pleasure and satisfaction in the practise of the hobby.

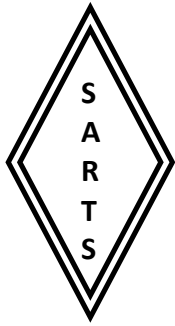
2 The services provided to members of the Society include:

- Teaching on radio theory and morse to all those who aspire to become licensed radio operators.
- Library service
- Despatch to all overseas countries and collection of QSL cards.
- Compilation of a local amateur radio "call book" listing out all licensed operators in Singapore for local use and submission to international call book publishers.
- Maintaining a two meter repeater station.
- International representation by membership of International Amateur Radio Union.
- Provide opportunity for community service through communication support for selected voluntary organisations.
- Liaison with the authorities on licensing conditions and spectrum usage matters.

3 Meeting of the Society are held on the last Thursday of every month, (excluding December) at 8.00 pm at the Singapore Medical Alumni Association, No. 2 College Road, Singapore 0316.

4 The Society could be contacted by post and further inquiries could be addressed to the Hon Secretary, **Singapore Amateur Radio Transmitting Society**, P O Box 2728 Singapore 904728. For convenience, a membership application form is attached.

5 Since the Secretary and membership of the SARTS council change every year, publication of contact telephone numbers in this Hand Book is inappropriate as the information will be out dated periodically.



SINGAPORE AMATEUR RADIO TRANSMITTING SOCIETY

Robinson Road P.O. Box 2728

Singapore 904728

<http://www.sarts.org.sg>

Application for Membership

ORDINARY MEMBER

ASSOCIATE MEMBER

NAME _____ CALL SIGN _____

HANDLE _____ NATIONALITY _____ SEX
M/F

(Short name)

OTHER CALL SIGNS _____ WHEN FIRST LICENCE _____

IDENTITY CARD/PASSPORT NO.

_____ COUNTRY _____

DATE OF

BIRTH _____ OCCUPATION _____

POSTAL ADDRESS:- (All correspondence will be sent to a Singapore address only)

_____ SINGAPORE ()

RESIDENCE ADDRESS – (If different from Postal Address)

_____ SINGAPORE ()

CONTACT INFORMATION: PHONE (HOME) _____
(OFFICE) _____

HANDPHONE _____ PAGER _____
Fax(OFFICE) _____

EMAIL _____

CHEQUE No. _____ BANK _____ AMOUNT
S\$ _____

(Payable to "Singapore Amateur Radio Transmitting Society")

SIGNATURE _____ DATE _____

NOTE: Membership Fees: Ordinary Member S\$50 p.a. Associate Member S\$25 p.a.
Entrance Fee S\$10.

PLEASE FILL IN THE ABOVE INFORMATION AND RETURN WITH YOUR PAYMENT TO:

**THE HON. SECRETARY
SINGAPORE AMATEUR RADIO TRANSMITTING SOCIETY
Robinson Road P.O. Box 2728
SINGAPORE 904728**

MEMBERSHIP APPROVED BY SARTS COUNCIL ON: