

## **LMD-401 458–462.5 MHz**

### **Data transceiver for use in the USA under FCC Part 90 License**

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**Those who are familiar with the licensing process and narrow banding history in the USA, please read from 1-3).**

## **1) Acquisition of FCC License with the LMD-401**

### **1-1) Radio regulations for unlicensed Short Range Devices (SRD) in the USA**

Most low power ISM band radio modules in the USA operate under the popular FCC Part 15.231 (typically 315 MHz, 418 MHz or 433 MHz) and FCC Part 15.249 (902-928 MHz, 2400-2483.5 MHz, and 5725-5875 MHz, 24.0-24.25GHz). These unlicensed bands have a limitation on RF output power, which restricts the operating range to a very short distance compared with European SRDs where the typical RF power (ERP) limit is 10 mW.

Part 15.247 is another popular unlicensed band that allows higher RF power (maximum peak conducted output power) in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, but it is limited for frequency hopping and digitally modulated systems.

For narrow band radio applications that require a longer operating range (preferably in the 400 MHz band which has good propagation characteristics), Industrial Band Radio systems are licensed under Title 47 Part 90 Code of Federal Regulations and the Federal Communications Commission (hereafter referred to as FCC Part 90).

### **1-2) FCC Part 90 and the LMD-401**

FCC Part 90 concerns Private Land Mobile Radio (PLMR) services. On high-power channels, 100-500 W PLMR transmitters are popularly operated at far higher power than SRDs. For low power transmitters like the LMD-401, it is essential to operate on the channels that the FCC set aside exclusively for low-power use. A specific sub-part of channels that are exclusively assigned for low-power use suitable for the LMD-401 is titled **“Part 90. 267 Assignment and use of frequencies in the 450–470 MHz band for low power use.”**

### **1-3) Part 90 Equipment Authorization of the LMD-401**

The LMD-401 is an OEM transceiver module for integration in user products. It has received an Equipment Authorization (Certification) and FCC ID pursuant to Part 90.217.

Equipment Authorization for end products that integrate the LMD-401 is not necessary if they fulfill the conditions of the Equipment Authorization granted to the LMD-401.

FCC ID of the LMD-401: V9X-LMD401

Information concerning Equipment Authorization of the LMD-401 is available at the following FCC website. <http://www.fcc.gov/oet/>

#### **1-4) Obtaining a radio station license**

To operate an end product that integrates the LMD-401 in the USA, a radio station license must be obtained for the end product. An FCC Certified Frequency Coordinator is a party who offers services for frequency coordination and FCC license application. They research the frequency channels in the PLMRS frequency pool by checking the eligibility requirements (presented in the “Limitations” column of Industrial/Business Frequency Table as noted in 47 CFR 90.35) and select frequency channels that are available and suitable for the application of the end product from the scope of frequency channels that can be programmed by end products that integrate the LMD-401. They then select frequency channels that will not be subject to interference in the relevant region and apply for a radio station license for these frequency channels.

#### **1-5) Frequency coordinator**

The following FCC site shows a list of Certified Frequency Coordinators.

<https://www.fcc.gov/wireless/bureau-divisions/mobility-division/industrial-business/industrial-business-licensing>

They provide frequency coordination and license application services.

FIT, a frequency coordinator, provided professional advice when Circuit Design decided the frequency-tuning range (458–462.5 MHz) of the LMD-401, bearing in mind the user applications and the RF specification of the LMD-401. For license applications for the end products that integrate the LMD-401, we recommend users consult FIT since they are familiar with the typical applications and operations of end customers of the LMD-401. If you provide the RF specifications of the end product with details of the application and planned use in the US, they will offer effective license acquisition services. As they say, “We can help your customers get their licenses quickly. We need to determine what kind of license is required and the best way to do get licensed. That is our specialty.”

FIT

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<http://www.landmobile.com/>

## **2) Frequency channels that can be licensed**

### **2-1) Frequency channels covered by the LMD-401**

The maximum frequency range of the LMD-401 (designed for use under FCC Part 90) is 458–462.5 MHz. In practice, in the customer application, the user CPU (which directly controls the PLL frequency synthesizer in the LMD-401) sets the channel frequency of the LMD-401.

The frequency channel table for the LMD-401 on pages 10-12 is an example of the channel plan. It presents all the possible frequency channels in 12.5 kHz channel steps, covering the entire span of 458–462.5MHz (hereinafter referred to as “switching range”).

### **2-2) Frequency channels that can be licensed**

Finding frequency channels that can be licensed involves searching through the frequency channels available for the LMD-401 (channels within the switching range of the LMD-401) to identify Part 90 frequency channels that can be licensed for the end product, but it is not easy. In addition, to be granted a license, it is necessary to use a frequency coordination service to avoid interference in the region where the end products are going to be used. Therefore, generally it is recommended to ask a frequency coordinator to identify the frequency channels that can be licensed.

### **2-3) Example of frequency channels that can be licensed**

As the RF output power of the LMD-401 is only 10 mW and very low compared with the popular PLMRS operated under Part 90, FCC Rules and Regulations Part 90.267 list channels in the 450–470 MHz band designated for low power use. Then we focus on the channels that fit the typical application of the LMD-401.

### **2-4) Part 90.267**

The title of Part 90.267 is “Assignment and use of frequencies in the 450-470 MHz band for low power use”.

Low power use frequency channels in Part 90.267 are divided into six frequency channel groups.

90.267	(b)	Group A1
90.267	(c)	Group A2
90.267	(d)	Group B
90.267	(e)	Group C
90.267	(f)	Group D
90.267	(g)	Low Power Public Safety Frequencies

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There are six considerations that determine the necessary licensing steps for the specific use of the LMD-401.

Involvement of coordinator	Coordinated basis / non coordinated basis
Area	Limited area / <b>nationwide</b> / <b>itinerant use</b>
Nature of signal sent	Voice / <b>non-voice</b>
Nature of radio station	Portable/ mobile / fixed / base station
RF power, height of antenna	Maximum ERP, Maximum antenna height
Special application	Central station alarm, Low power public safety

We define the typical application of the LMD-401 to be “portable telemetry or remote control” and select the ideal frequency groups that mostly fulfill the following desired conditions.

No limitation of the area: nationwide
Can be used in many different places: itinerant use
Priority to data transmission: non-voice

Group C and Group B and Low Power Public Safety Frequencies are the frequency groups that partly fit the above-mentioned conditions. Most Group A, B, D and Low Power Public Safety channel stations are licensed only for a limited geographical area and they must not operate outside the licensed area. If the user needs to travel throughout the US, then they must choose the Group C frequencies that are licensed for itinerant use on a nationwide Basis. Group B frequencies are for non-voice operations on a primary basis, which is an advantage for telemetry and remote control applications. Group A1 and A2 channels are co-primary between voice and non-voice (=data) operations. While not perfectly ideal for data only operations, these are channels that frequency coordinators can consider for the LMD-401 units.

Below, we quote the main clause and the frequency channels of Group C, Group B, Group D and Low Power Public Safety Frequencies in Part 90.267 and mark the channels that can be covered by 12.5 kHz step channels that fit in the scope of the switching range (458–462.5 MHz) of the LMD-401. The colored channels are the candidates for channels that can be licensed. You can see that not all channels are available. Note that the frequencies are allocated by the FCC in “Pairs” that are 5 MHz apart, however, the transmitter is capable of programming only on the channels that fall in the 458-462.5 MHz range. Care must be taken by the Frequency Coordinator to make sure the licensed channel is within the programming range of the LMD-401 and is in the correct user-group.

**2-5) Part 90.267(e) Group C frequencies**

This is the group of channels that allows license of nationwide and itinerant use without the involvement of frequency coordinator. The licensed channels can be used anywhere in the US, but there is no protection from/to existing stations. This is ideal for remote control systems that move around the USA, but the user must accept the possibility of interference from other stations. Even though these channels are itinerant, they still **MUST BE LICENSED**. The user may apply for these on-line at the FCC's website. The on-line License application process is somewhat difficult and the assistance of an experienced radio technician or Frequency Coordinator is advised.

(e) Group C Frequencies. The Industrial/Business Pool frequencies in Group C are available <b>nationwide for non-coordinated itinerant use</b> as follows.			
(1) Group C frequencies are available for voice and non-voice operations on a co-primary basis. Only mobile operations will be authorized on Group C frequencies. Stations may operate at fixed locations for a temporary period of time. No stations operating at a permanent fixed location will be authorized on Group C frequencies.			
(2) Operation on these frequencies is limited to 6 watts effective radiated power for fixed or mobile units and 2 watts ERP for portable units. Stations operating at fixed locations for a temporary period of time will be limited to an antenna height of 7 meters (20 feet) above ground.			
(3) The Industrial/Business Pool Group C Low Power Frequencies are as follows:			
461/466.03125	461/466.15625	461/466.28125	462.8125
<b>461/466.0375</b>	<b>461/466.1625</b>	<b>461/466.2875</b>	462.8375 (unpaired)
461/466.04375	461/466.16875	461/466.29375	462/467.8625
461/466.05625	461/466.18125	461/466.30625	462/467.8875
<b>461/466.0625</b>	<b>461/466.1875</b>	<b>461/466.3125</b>	462/467.9125
461/466.06875	461/466.19375	461/466.31875	464/469.48125
461/466.08125	461/466.20625	461/466.33125	464/469.4875
<b>461/466.0875</b>	<b>461/466.2125</b>	<b>461/466.3375</b>	464/469.5125
461/466.09375	461/466.21875	461/466.34375	464/469.51875
461/466.10625	461/466.23125	461/466.35625	464/469.53125
<b>461/466.1125</b>	<b>461/466.2375</b>	<b>461/466.3625</b>	464/469.5375
461/466.11875	461/466.24375	461/466.36875	464/469.5625
461/466.13125	461/466.25625	462.7625 (unpaired)	464/469.56875
<b>461/466.1375</b>	<b>461/466.2625</b>	462.7875 (unpaired)	
461/466.14375	461/466.26875	462.8125 (unpaired)	

**2-6) Part 90.267(d) Group B frequencies**

This is the group of channels that allows nationwide licenses on a coordinated basis\*. The advantage of this group for the LMD-401 is that the channels are available for non-voice (=data) operations on a primary basis.

\*The coordinator chooses the best channel for the licensee, based on the greatest distance from existing licensees. Protection from interference is enhanced. This avoids causing/receiving interference.

(d) Group B Frequencies. The Industrial/Business Pool frequencies in Group B are available **nationwide on a coordinated basis**, pursuant to § 90.35(b)(2) and § 90.175(b) as follows:

(1) Group B frequencies are **available for non-voice operations on a primary basis**. Voice operations will be permitted on a secondary basis. Base, mobile or operational fixed stations will be authorized on Group B frequencies. Fixed stations may be licensed as mobile.

(2) Operation on these frequencies is limited to 6 watts ERP for base, mobile or operational fixed stations and 2 watts ERP for portable units. A maximum antenna height of 7 meters (20 ft) above ground is authorized for fixed stations.

(3) The Industrial/Business Pool Group B Frequencies are as follows:

462/467.20625	462/467.28125	462/467.35625	462/467.43125
<b>462/467.2125</b>	<b>462/467.2875</b>	<b>462/467.3625</b>	<b>462/467.4375</b>
462/467.21875	462/467.29375	462/467.36875	462/467.44375
462/467.23125	462/467.30625	462/467.38125	
<b>462/467.2375</b>	<b>462/467.3125</b>	<b>462/467.3875</b>	
462/467.24375	462/467.31875	462/467.39375	
462/467.25625	462/467.33125	462/467.40625	
<b>462/467.2625</b>	<b>462/467.3375</b>	<b>462/467.4125</b>	
462/467.26875	462/467.34375	462/467.41875	

**2-7) Part 90.267 (f) Group D frequencies**

This is the group of frequencies that are available only for central station alarm operation (“Alarm Station” for Burglar or fire alarm) use. Telemetry operation is available under certain condition.

(f) *Group D Frequencies*. The Industrial/Business Pool frequencies in Group D are available on a **coordinated basis**, pursuant to [§§ 90.35\(b\)\(2\)](#) and [90.175\(b\)](#). Central

station alarm signaling on these frequencies are co-primary with regard to co-channel or adjacent channel base, mobile or data operations.

(1) Base, mobile or operational fixed stations will be authorized on Group D frequencies. Fixed stations may be licensed as mobile.

(2) Unless concurrence is obtained in accordance with [section 90.175\(b\) of this chapter](#) from the Commission-certified frequency coordinator for frequencies designated for central station alarm operations, Group D frequencies subject to [§ 90.35\(c\)\(63\)](#) are limited to central station alarm use within the urban areas described in [§ 90.35\(c\)\(63\)](#). **Outside the urban areas described in Sec. 90.35(c)(63), Group D frequencies subject to Sec. 90.35(c)(63) are available for general Industrial/Business use on a coordinated basis**, pursuant to Sec. 90.35(b)(2) and Sec. 90.175(b).

(3) Unless concurrence is obtained in accordance with [section 90.175\(b\) of this chapter](#) from the Commission-certified frequency coordinator for frequencies designated for central station alarm operations, Group D frequencies subject to [§ 90.35\(c\)\(66\)](#) are limited to central station alarm use nationwide.

(4) Operation on Group D frequencies is limited to 2 watts output power for mobile, base or operational fixed stations. Fixed stations used for central station alarm operations may utilize antennas mounted not more than 7 meters (20 feet) above a man-made supporting structure, including antenna structure.

(5) The Industrial/Business Pool Group D Low Power Frequencies are as follows:

460/465.90625	460/465.95625
461/466.00625	
<b>460/465.9125</b>	<b>460/465.9625</b>
<b>461/466.0125</b>	
460/466.91875	460/465.96875
461/466.01875	
460/465.93125	460/465.98125
<b>460/465.9375</b>	<b>460/465.9875</b>
460/465.94375	460/465.99375

## 2-8) Part 90.267 (g) Low Power Public Safety Frequencies

This is the group of channels that allows nationwide licenses on a coordinated basis. Public Safety is ONLY for Police/Fire and other Government agency use.

(g) Low Power Public Safety Frequencies. The frequencies in the Public Safety Pool Low Power Group are available nationwide on a coordinated basis, pursuant to Sec. 90.20(c)(2) and Sec. 90.175(b).

(1) Base, mobile or operational fixed stations will be authorized on Public Safety Low Power frequencies. Fixed stations may be licensed as mobile.

(2) Operation on these frequencies is limited to 6 watts effective radiated power for base, mobile or operational fixed stations and 2 watts ERP for portable units. A maximum antenna height of 7 meters (20 feet) above ground is authorized for fixed stations.

(3) The Public Safety Pool Low Power Frequencies are as follows:

453/458.03125	453/458.13125	453/458.95625	460/465.53125
453/ <b>458.0375</b>	453/ <b>458.1375</b>	453/ <b>458.9625</b>	<b>460/465.5375</b>
453/458.04375	453/458.14375	453/458.96875	460/465.54375
453/458.05625	453/458.88125	453/458.98125	460/465.55625
453/ <b>458.0625</b>	453/ <b>458.8875</b>	453/ <b>458.9875</b>	<b>460/465.5625</b>
453/458.06875	453/458.89375	453/458.99375	460/465.56875
453/458.08125	453/458.90625	460/465.48125	
453/ <b>458.0875</b>	453/ <b>458.9125</b>	<b>460/465.4875</b>	
453/458.09375	453/458.91875	460/465.49375	
453/458.10625	453/458.93125	460/465.50625	
453/ <b>458.1125</b>	453/ <b>458.9375</b>	<b>460/465.5125</b>	
453/458.11875	453/458.94375	460/465.51875	

## LMD-401 458–462.5 MHz Frequency channel table (Example)

Channel span: 12.5 kHz

Coverage: 458.00–462.50 MHz

Part 90.267 low power use frequencies are marked

Frequencies in bold type and colored are the frequencies designated for low power use defined by:

### 90.267 Assignment and use of frequencies in the 450–470 MHz band for low power use

<b>Frequency colored in Red</b>	Part 90.267 Group A1 Frequencies in Industrial/Business Pool
<b>Frequency colored in blue</b>	Part 90.267 Group B Frequencies in Industrial/Business Pool
<b>Frequency colored in green</b>	Part 90.267 Group C Frequencies in Industrial/Business Pool
<b>Frequency colored in brown</b>	Part 90.267 Group D Frequencies in Industrial/Business Pool
<b>Frequency colored in pink</b>	Part 90.267 Low Power Public Safety Frequencies

1	458	459	460	461	462
2	458.0125	459.0125	460.0125	<b>461.0125</b>	462.0125
3	458.025	459.025	460.025	461.025	462.025
4	<b>458.0375</b>	459.0375	460.0375	<b>461.0375</b>	462.0375
5	458.05	459.05	460.05	461.05	462.05
6	<b>458.0625</b>	459.0625	460.0625	<b>461.0625</b>	462.0625
7	458.075	459.075	460.075	461.075	462.075
8	<b>458.0875</b>	459.0875	460.0875	<b>461.0875</b>	462.0875
9	458.1	459.1	460.1	461.1	462.1
10	<b>458.1125</b>	459.1125	460.1125	<b>461.1125</b>	462.1125
11	458.125	459.125	460.125	461.125	462.125
12	<b>458.1375</b>	459.1375	460.1375	<b>461.1375</b>	462.1375
13	458.15	459.15	460.15	461.15	462.15
14	458.1625	459.1625	460.1625	<b>461.1625</b>	462.1625
15	458.175	459.175	460.175	461.175	462.175
16	458.1875	459.1875	460.1875	<b>461.1875</b>	<b>462.1875</b>
17	458.2	459.2	460.2	461.2	462.2
18	458.2125	459.2125	460.2125	<b>461.2125</b>	<b>462.2125</b>

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19	458.225	459.225	460.225	461.225	462.225
20	458.2375	459.2375	460.2375	461.2375	462.2375
21	458.25	459.25	460.25	461.25	462.25
22	458.2625	459.2625	460.2625	461.2625	462.2625
23	458.275	459.275	460.275	461.275	462.275
24	458.2875	459.2875	460.2875	461.2875	462.2875
25	458.3	459.3	460.3	461.3	462.3
26	458.3125	459.3125	460.3125	461.3125	462.3125
27	458.325	459.325	460.325	461.325	462.325
28	458.3375	459.3375	460.3375	461.3375	462.3375
29	458.35	459.35	460.35	461.35	462.35
30	458.3625	459.3625	460.3625	461.3625	462.3625
31	458.375	459.375	460.375	461.375	462.375
32	458.3875	459.3875	460.3875	461.3875	462.3875
33	458.4	459.4	460.4	461.4	462.4
34	458.4125	459.4125	460.4125	461.4125	462.4125
35	458.425	459.425	460.425	461.425	462.425
36	458.4375	459.4375	460.4375	461.4375	462.4375
37	458.45	459.45	460.45	461.45	462.45
38	458.4625	459.4625	460.4625	461.4625	462.4625
39	458.475	459.475	460.475	461.475	462.475
40	458.4875	459.4875	460.4875	461.4875	462.4875
41	458.5	459.5	460.5	461.5	462.5
42	458.5125	459.5125	460.5125	461.5125	
43	458.525	459.525	460.525	461.525	
44	458.5375	459.5375	460.5375	461.5375	
45	458.55	459.55	460.55	461.55	
46	458.5625	459.5625	460.5625	461.5625	
47	458.575	459.575	460.575	461.575	
48	458.5875	459.5875	460.5875	461.5875	
49	458.6	459.6	460.6	461.6	
50	458.6125	459.6125	460.6125	461.6125	
51	458.625	459.625	460.625	461.625	
52	458.6375	459.6375	460.6375	461.6375	
53	458.65	459.65	460.65	461.65	

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54	458.6625	459.6625	460.6625	461.6625	
55	458.675	459.675	460.675	461.675	
56	458.6875	459.6875	460.6875	461.6875	
57	458.7	459.7	460.7	461.7	
58	458.7125	459.7125	460.7125	461.7125	
59	458.725	459.725	460.725	461.725	
60	458.7375	459.7375	460.7375	461.7375	
61	458.75	459.75	460.75	461.75	
62	458.7625	459.7625	460.7625	461.7625	
63	458.775	459.775	460.775	461.775	
64	458.7875	459.7875	460.7875	461.7875	
65	458.8	459.8	460.8	461.8	
66	458.8125	459.8125	460.8125	461.8125	
67	458.825	459.825	460.825	461.825	
68	458.8375	459.8375	460.8375	461.8375	
69	458.85	459.85	460.85	461.85	
70	458.8625	459.8625	460.8625	461.8625	
71	458.875	459.875	460.875	461.875	
72	458.8875	459.8875	460.8875	461.8875	
73	458.9	459.9	460.9	461.9	
74	458.9125	459.9125	460.9125	461.9125	
75	458.925	459.925	460.925	461.925	
76	458.9375	459.9375	460.9375	461.9375	
77	458.95	459.95	460.95	461.95	
78	458.9625	459.9625	460.9625	461.9625	
79	458.975	459.975	460.975	461.975	
80	458.9875	459.9875	460.9875	461.9875	