

Document No.	CDSP-0043e
	First edition

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# PRODUCT SPECIFICATION

Description	High performance synthesized transceiver
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Type name	LMD-400-R 458-462.5 MHz
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Type number	U060B01-C
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Date submitted	
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Specification sheet received by:
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Presented by

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Revision History				
Edition	Date	Revision details	Prepared	Approved
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(\*1) If any component are found to be unavailable, equivalent components may be used within the specified electrical characteristics.

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## 1. Scope

This document shall apply to the High performance synthesized transceiver delivered to

## 2. Description

High performance synthesized transceiver

## 3. Type name, Frequency, Type number

3-1	Type name	LMD-400-R 458-462.5 MHz
3-2	Frequency	458-462.5 Mhz
3-3	Type number	U060B01-C

## 4. General specification

**\*The MIN/TYP/MAX values for the RF output power and BER are specified in the range of operation environment temperature.**

**\*All values in the Specification column are specified at 25 °C+/-10 °C unless otherwise noted.**

	Item	Unit	Specification	Remarks	MIN	TYP	MAX
4-1	Applicable standard		FCC Part 90.267				
4-2	Communication method		One-way, Half-duplex				
4-3	Emission class		F1D				
4-4	Modulation method		GFSK				
4-5	Operating frequency range	MHz	458 - 462.5 MHz band		458		462.5
4-6	Operation temperature range	°C	-20 to +60	No dew condensation	-20		60
4-7	Storage temperature range	°C	-30 to +75	No dew condensation	-30		75
4-8	Aging rate	ppm	≤ +/-1 /year	TX freq., RX Lo freq.	-1		1
4-9	Initial frequency tolerance*	ppm	+/- 1.5	TX freq., RX Lo freq.	-1.5		1.5
4-10	Dimensions	mm	30 x 50 x 9	Not including protrusion			
4-11	Weight	g	25				

\* Initial frequency tolerance : At delivery

Frequency drift at delivery within 1 year after the final adjustment

## 5. Electrical specification

### 5-1 Common to TX/RX

	Item	Unit	Specification	Remarks	MIN	TYP	MAX
5-1-1	Oscillation type		PLL controlled VCO				
5-1-2	Frequency stability	ppm	+/- 2.5 (-20°C to +60°C)	Reference temp.= 25 °C	-2.5		2.5
5-1-3	TX/RX switching time	ms	15 (DI vs DO)	Recommended preamble 20 ms		15	20
5-1-4	Channel step	kHz	12.5			12.5	
5-1-5	Data rate	bps	4800	DO/DI	2400		4800
5-1-6	Max. pulse width	ms	15	DO/DI		15	20
5-1-7	Min. pulse width	μs	200	DO/DI	200		
5-1-8	Data polarity		Positive	DI vs DO			
5-1-9	PLL reference frequency	MHz	21.25 (TCXO)			21.25	
5-1-10	PLL response	ms	30	from PLL setting to LD out		30	60
5-1-11	Antenna impedance	Ω	50 (Nominal)			50	
5-1-12	Operating voltage	V	3 - 5.5		3		5.5
5-1-13	TX consumption current	mA	52	Vcc = 3.0 V		52	
5-1-14	RX consumption current	mA	42	Vcc = 3.0 V		42	

For the specifications and other details of the PLL interface, refer to the data sheet of the MB15E03SLP(FUJITSU) and make sure to use within its specifications.

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## 5-2 Transmitter

	Item	Unit	Specification	Remarks	MIN	TYP	MAX
5-2-1	RF output power (at 25 °C)	mW	10	Conducted 50 Ω	7.2	10	14
5-2-2	RF output power (-20 - +60°C)	mW	10	Conducted 50 Ω	5		15
5-2-3	Deviation	kHz	±2.4	PN9 4800 bps	±2.0	±2.4	± 2.8
5-2-4	DI input level	V	L= GND, Hi=3 V- Vcc				5.5
5-2-5	Residual FM noise	kHz	0.08	DI=L, LPF=20 kHz		0.08	
5-2-6	Spurious emission	dBm	-37 (50 Ω conducted)	< 1000 MHz			-37
		dBm	-31 (50 Ω conducted)	> 1000 MHz			-31
5-2-7	Emission mask	dB	TBD				
5-2-8	Adjacent channel power	nW	200 (PN9-4800 bps)				200
5-2-9	Occupied bandwidth	kHz	8.5 (PN9-4800 bps)			8.5	11.25

## 5-3 Receiver

	Item		Specification	Remarks	MIN	TYP	MAX
5-3-1	Receiver type		Double superheterodyn				
5-3-2	1st IF frequency	MHz	21.7			21.7	
5-3-3	2nd IF frequency	kHz	450			450	
5-3-4	Maximum input level	dBm	10				10
5-3-5	BER (0 error/2556 bits)	dBm	-113	PN 9 4800 bps		-113	
5-3-6	BER (1 % error)	dBm	-116	PN 9 4800 bps		-116	
5-3-7	Sensitivity 12dB/ SINAD	dBm	-116	fm1 kHz/ dev 2.4 kHz CCITT		-116	
5-3-8	Co-channel rejection	dB	-7	D/U ration		-7	
5-3-9	Spurious response rejections	dB	70 (1 st MIX)	Two signal method, 1 % error		70	
		dB	70 (2 nd MIX)			70	
5-3-10	Adjacent CH selectivity	dB	65 (25 k ch)			65	
			55 (12.5 k ch)			55	
5-3-11	Blocking	dB	84 (Unwanted signal+/-1M)			84	
5-3-12	DO output level	V	L = GND Hi= 2.8 V				2.8
5-3-13	RSSI rising time	ms	30 (from PLL setup)	CH shift of 25 kHz		30	50
5-3-14	Time until valid Data-out	ms	50 (from PLL setup)	CH shift of 25 kHz		50	100
5-3-15	RSSI rising time	ms	50 (from PLL setup)	When power ON		50	70
5-3-16	Time until valid Data-out	ms	70 (from PLL setup)	When power ON		70	120
5-3-17	Spurious radiation (1st Lo)	dBm	-57(50 Ω conducted)			-60	-57
5-3-18	RSSI		290	with -100 dBm	240	290	340
		mV	220	with -110 dBm	170	220	270

The maximum allowable MPE value of 0.305 mW/cm<sup>2</sup> will be reached in a distance of 20 cm in case that an antenna gain less than 22 dBi will be used.

**BER:** RF level where no error per 2556 bits is confirmed with the signal of PN9 and 4800 bps.

**BER (1 % error) :** RF level where 1% error per 2556 bits is confirmed with the signal of PN9 and 4800 bps.

**Spurious response, CH selectivity :** The deviation of the unwanted signal is 12% of the channel separation(=1.5 kHz). Modulation frequency is 400Hz.

**Time until valid Data-out :** Valid DO is determined at the point where Bit Error Rate meter starts detecting the signal of 4800bps, 1010repeated signal.

### Conditions

All specifications are specified based on the data measured in a shield room using the PLL setting controller board prepared by Circuit Design.

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## 7. Environmental reliability test

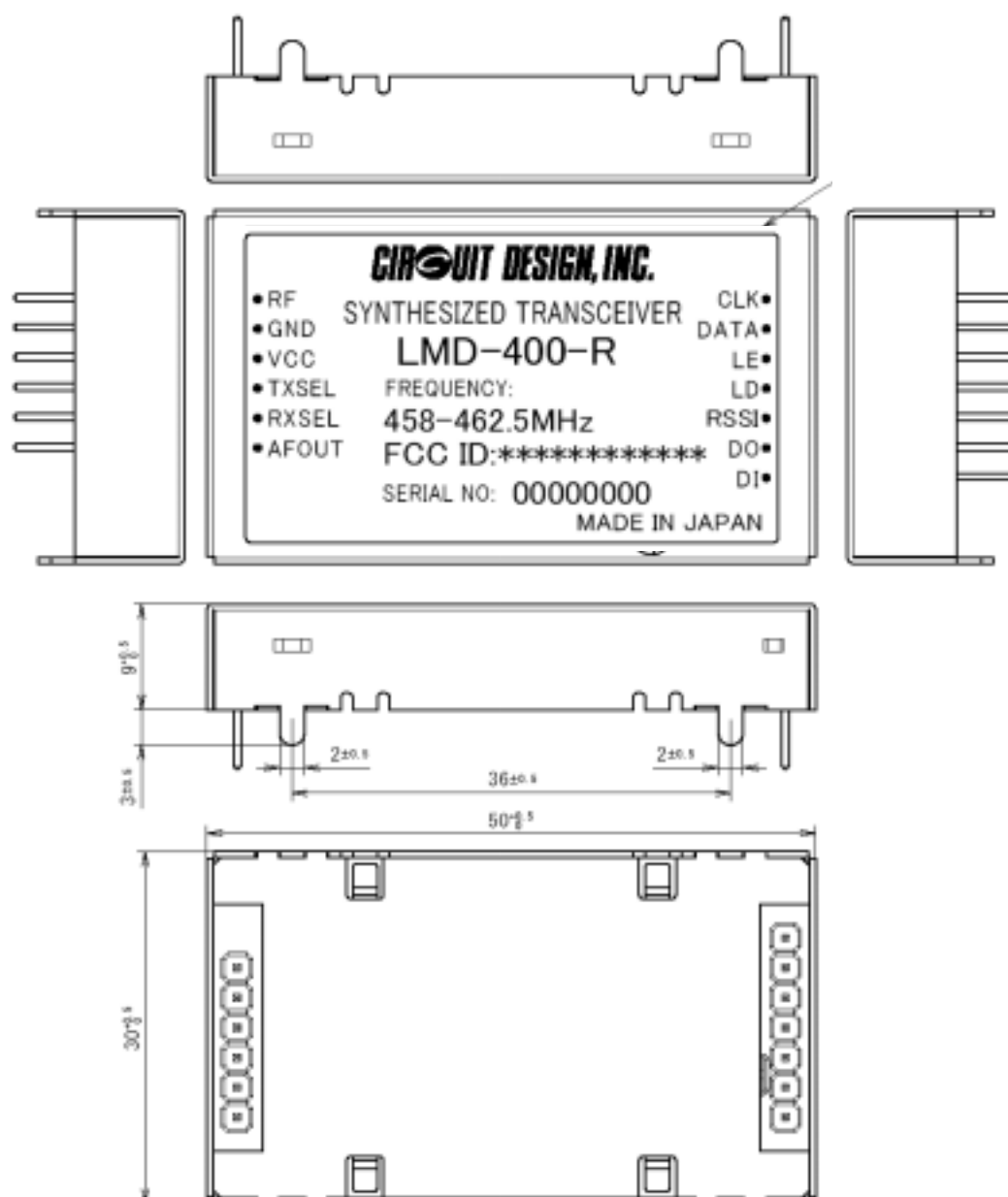
### 7-1 Test Item

Item	Test conditions / Test method
Temperature characteristics	-20°C to + 65°C (10°C step, Power kept on during test) TX frequency, TX output power, deviation and TX current consumption should be recorded. RX Lo frequency, RX sensitivity, RX current consumption should be recorded. Specifications should be met .
Low temp. exposure	Left at -30 °C for 96 h. (Operation test should be performed after being left at 25 °C for 2h) Electrical performance specifications should be met
High temp. exposure	Left at +85 °C for 96 h. (Operation test should be performed after being left at 25 °C for 2h) Electrical performance specifications should be met
Low temp. operation	Left at -20 °C for 24 h. (Power kept turned off while being left) Electrical performance specifications should be met
High temp. operation	Left at + 60 °C for 24 h. (Power kept turned off while being left) Electrical performance specifications should be met
High temp. and high humidity exposure	Left at +65 °C and humidity 95% for 48 h. (Operation test should be performed after being left at 25 °C for 2h) Electrical performance specifications should be met
Temperature cycle	5 cycles. 1 cycle= 3h each at -25°C and at +65 °C. (Operation test should be performed after being left at 25 °C for 2h) Electrical performance specifications should be met
Temp and humidity cycle	6 cycles. 1 cycle=12h from +25°C to 55 °C and humidity 95%. (Operation test should be performed after being left at 25 °C for 2h) Electrical performance specifications should be met
Vibration test	6G (58.8 m/s), 20-200 Hz, One-way sweep 15 min., 2h for each XYZ direction. Electrical performance specifications should be met
Drop test	Free fall from the height of 0.75m to a wooden ground. 3 times on each surface (Connector surface excluded) Electrical performance specifications should be met
ESD test	+/- 12 kV 150ohm 150pF (Power kept on during test) Antenna part should be targeted with being connected to the module. Test voltage should not be directly applied to the electrical circuit and components Electrical performance specifications should be met

### 7-2 Test result

No malfunction was observed.

## 8. External view



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## 9. Warranty & Cautions

**This product is not supposed to be used for the applications such as life-support equipment, which require high reliability.**

### Warranty

CIRCUIT DESIGN represents and warrants hereby that the Products defined in these specifications is free from any defect in material and workmanship and that the Products conform to the specifications. Warranty of the Products by CIRCUIT DESIGN shall be limited to the repair or replacement of the defective Products without charge when the defect is notified to CIRCUIT DESIGN in writing within twelve (12) months after the date of shipment of the Products. The warranty of repair or replacement hereunder shall be the only warranty, either express, implied or statutory, all other warranties of title, non-infringement, merchantability and fitness for purpose being expressly disclaimed.

### Limit of liability

With the exception of the scope of Warranty specified above, CIRCUIT DESIGN 's total liability is limited to the price of the Products paid by Buyer with respect to which losses or damages are claimed. In no event shall CIRCUIT DESIGN be liable to anyone for special, collateral, indirect, exemplary, incidental or consequential damage, such damages to include but not limited to, cost of rework, retesting or removal and reinstallation of goods, loss of goodwill, loss of profits or loss of use.

### Cautions

- \* Take sufficient safety measures for the system or equipment in which the radio module is used.
- \* There are cases where radio communication may be temporarily cut off due to the influence of the surrounding noise or multipath fading even within the possible radio transmission range. Ensure that the system can be operated safely at all times even if this occurs.
- \* The surrounding environment will affect communication performance, so communication tests should be carried out before actual use.
- \* Do not use the radio module at a performance level in excess of its specifications or outside its specified environment.
- \* Do not use the equipment within the vicinity of devices that may malfunction as a result of electronic radio waves from the radio module.
- \* Ensure that the power supply for the radio module is within the specified rating. Short circuits and reverse connections may result in overheating and damage, and must be avoided at all costs.
- \* Ensure that the power supply has been switched off before attempting any wiring work. The case is connected to the GND terminal of the internal circuit, so do not make contact between the '+' side of the power supply terminal and the case.
- \* The radio module is neither waterproof nor splash proof. Ensure that it is not splashed with dirt or water. Do not use the equipment if water or other foreign matter has entered the case.
- \* Do not drop the radio module or otherwise subject it to strong shocks.
- \* Do not subject the equipment to condensation (including moving it from cold locations to locations with a significant increase in temperature.)
- \* Do not use the equipment in locations where it is likely to be affected by acid, alkalis, organic agents or corrosive gas.
- \* The GND for the radio module will also affect communication performance. If possible, ensure that the case GND and the circuit GND are connected to a large GND pattern.
- \* Do not take apart or modify the radio module.