Schindler Elevator Ltd
Switzerland

K-LC1 RADAR TRANSCEIVER

We, **Schindler elevators Ltd**

Zugerstrasse 13, CH-6030 EBIKON, Switzerland

USER MANUAL

Features

- 24 GHz K-band miniature transceiver
- 180MHz sweep FM input (n.a. for K-LC1a_V2)
- Dual 4 patch antenna
- Single balanced mixer with 50MHz bandwidth
- Beam aperture 80°/34°
- 15dBm EIRP output power
- 25x25mm$_2$ surface, 6mm thickness
- Lowcost design
- 3 pin version K-LC1a_V2 available

Applications

- General purpose movement detectors
- Security systems
- Object speed measurement systems
- Simple shortrange ranging detection
- Highspeed shortrange data transmission
- Industrial sensors

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Description

K-LC1a is a 8 patch Doppler module with an asymmetrical beam for lowcost short distance applications. Its typical applications are movement sensors in the security and automatic door domain. In building automation this module may be an alternative for infrared PIR or AIR systems thanks to its outstanding performance/cost ratio.
The module is extremely small and lightweight.
With its IF bandwidth from DC to 50MHz it opens many new applications.
FSK is possible thanks to the unique RFbeam oscillator design. This allows to use this lowcost module even in ranging applications.
Powerful starterkits with signal conditioning and visualization is available from RFbeam.
Find more informations at www.rfbeam.ch.

Characteristics

Parameter	Conditions / Notes	Symbol	Min	Typ	Max	Unit
Operating conditions						
Supply voltage		V_{cc}	4.75	5.0	5.25	V
Supply current	VCO Pin open	I_{cc}		35	45	mA
VCO pin resistance	Driving voltage source Note 1	R_{vco}		570		Ω
Operating temperature		T_{op}	-20		+60	°C
Storage temperature		T_{st}	-20		+80	°C
Transmitter						
Transmitter frequency	VCO pin left open, T_{amb}=-20°C .. +60°C	f_{TX}	24.075	24.125	24.175	GHz
Frequency drift vs temperature	V_{cc}=5.0V, -20°C .. +60°C Note 2	Δf_{TX}		-1		MHz/°C
Frequency tuning range		Δf_{vco}		180		MHz
VCO sensitivity		S_{vco}		-80		MHz/V
VCO Modulation Bandwidth	Δf=20MHz	B_{VCO}		3		MHz
Output power	EIRP	P_{TX}	+12	+15	+17	dBm
Output power deviation	Full VCO tuning range	ΔP_{TX}			+/- 1	dBm
Spurious emission	According to ETSI 300 440	P_{spur}			-30	dBm
Turn-on time	Until oscillator stable, Δf_{TX} < 5MHz	t_{on}		1		µs
Receiver						
Mixer Conversion loss	f_{IF} = 1kHz, IF load = 1kΩ	D_{mixer1}		-6		dB
	f_{IF} = 20MHz, IF load = 50Ω	D_{mixer2}		-11		dB
Antenna Gain	F_{TX}=24.125GHz Note 3	G_{Ant}		8.6		dB
Receiver sensitivity	f_{IF} =500Hz,B=1kHz,R_{IF} =1kΩ,S/N=6dB	P_{RX1}		-96		dBm
	f_{IF} =1MHz,B=20MHz,R_{IF} =50Ω,S/N=6dB	P_{RX1}		-84		dBm
Overall sensitivity	f_{IF} =500Hz,B=1kHz,R_{IF} =1kΩ,S/N=6dB	D_{system}		-111		dBc
IF output						
IF resistance		R_{IF}		50		Ω
IF frequency range	-3dB Bandwidth, IF load = 50Ω	f_{IF}	0		50	MHz
IF noise power	f_{IF} =500Hz, IF load = 50Ω	$P_{IFnoise1}$		-134		dBm/Hz
	f_{IF} =1MHz, IF load = 50Ω	$P_{IFnoise2}$		-164		dBm/Hz
IF noise voltage	f_{IF} =500Hz, IF load = 1kΩ	$U_{IFnoise1}$		-147		dBV/Hz
	f_{IF} =500Hz, IF load = 1kΩ	$U_{IFnoise1}$		45		nV/√Hz
IF output offset voltage	Full VCO range, no object in range	U_{IF}	10		200	mV
Supply rejection	Rejection supply pins to IF output	D_{supply}		26		dB

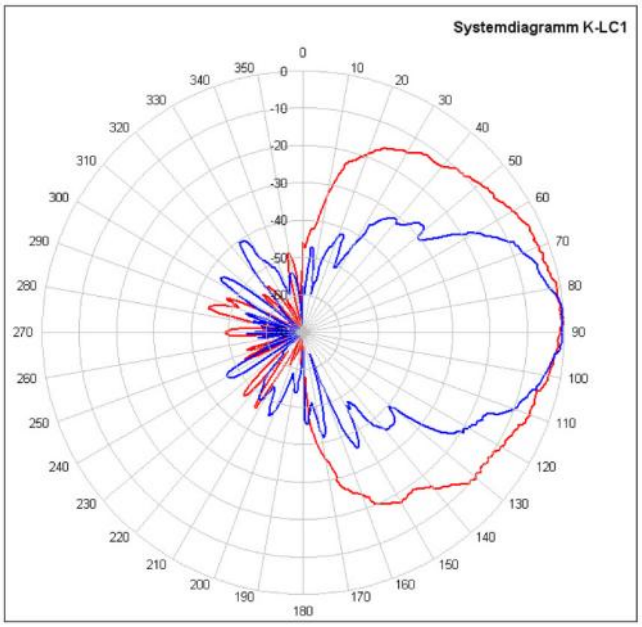
Parameter	Conditions / Notes	Symbol	Min	Typ	Max	Unit
Antenna						
Horizontal -3dB beamwidth	E-Plane	W_e		80		°
Vertical -3dB beamwidth	H-Plane	W_a		34		''
Horiz. sidelobe suppression		D_a		-12		dB
Vertical sidelobe suppression		D_e		-12		dB
Body						
Outline Dimensions				25*25*6		mm^3
Weight				4.5		g
Connector	5pin single row jumper					

Note 1: The VCP input has an internal voltage source with approx. 0.9 VDC. For driving this pin it is necessary to source and sink current.
Note 2: Transmit frequency stays within 24.075 to 24.175GHz over specified temperature range when the VCO pin is left open
Note 3: Theoretical value, given by design.

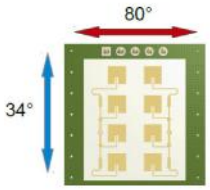
On this module the connector pin for the modulation input is not present. So this low-impedance input is always not connected, what is the best case. So there will never be any 'unwanted' modulation

Antenna System Diagram

This diagram shows module sensitivity in both azimuth and elevation directions. It incorporates the transmitter and receiver antenna characteristics.



Horizontal 80° , vertical 34° pattern
at IF output voltage -6dB
(corresponds to -3dB Tx power)



Remarks:
The broader the antenna, the narrower the beam.

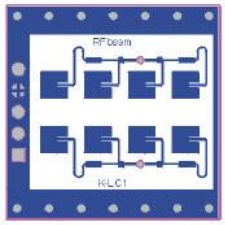
FM Characteristics

VCO Voltage generates an output signal even without an object in range because of the finite isolation between transmitter and receiver path. This effect is called self-mixing and leads to a DC signal that depends on the carrier frequency / the VCO voltage.

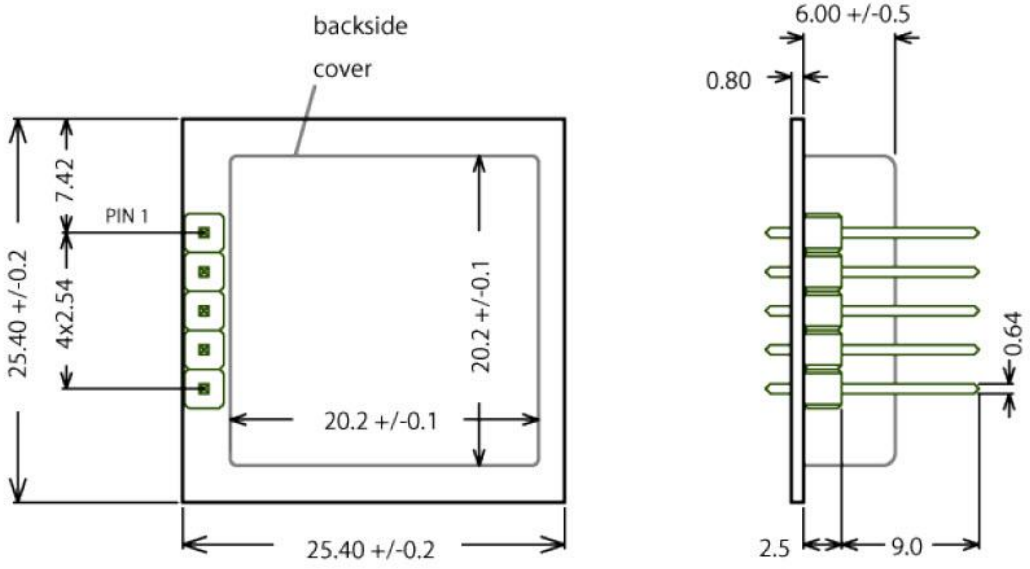
Pin Configuration

Pin	Description	Typical Value
1 *)	nc	---
2	VCC	5VDC supply
3	IF output	load 1kOhm
4	GND	ground
5 *)	VCO in	Open = f_0

*) not present in the option K-LC1a_V2



Outline Dimensions



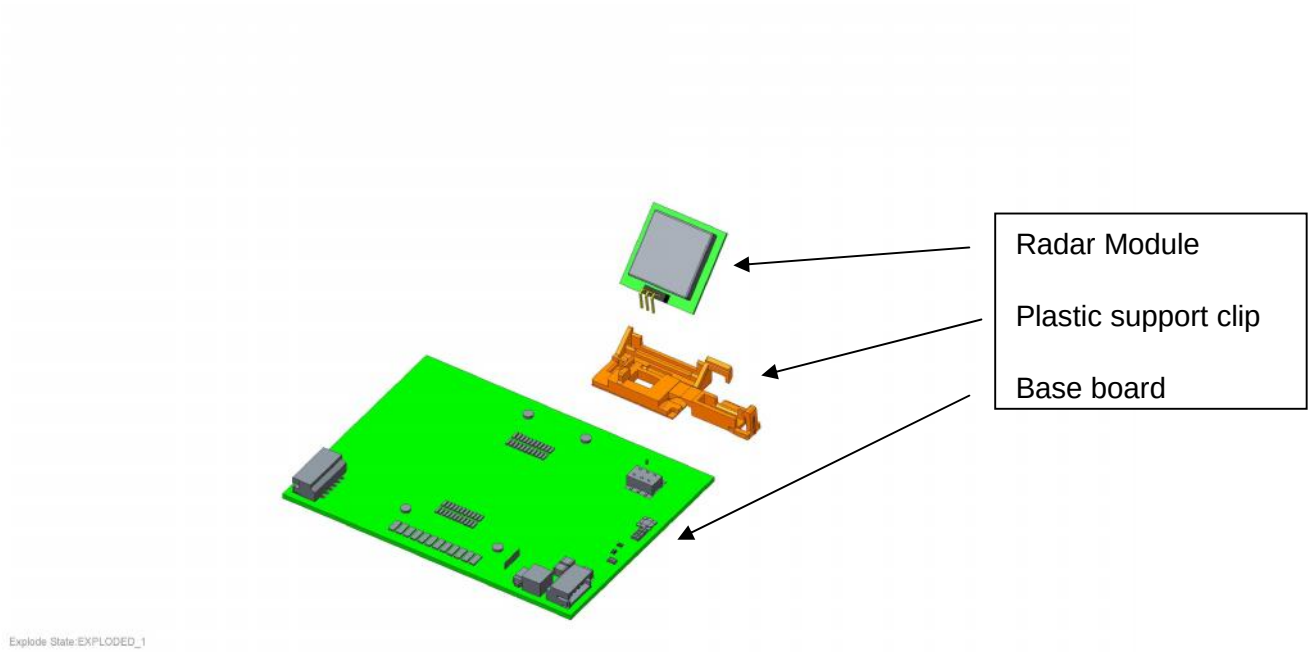
All Dimensions in mm

All values given are typical unless otherwise specified.

ASSEMBLY INFORMATION

Features

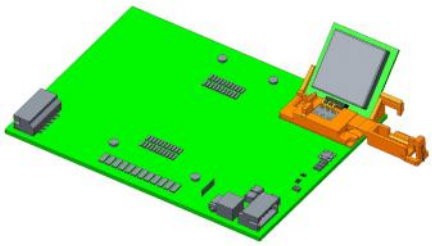
The radar module is mounted on a card reader pcb board and locked by a plastic support clip.



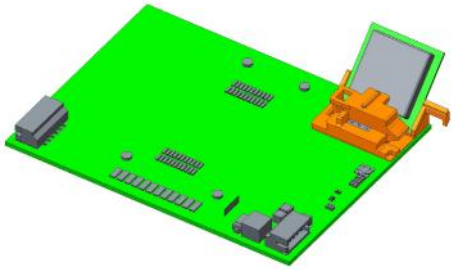
Assembly Diagram

Step 1: Place the plastic support on the Card reader board PCB.

Step 2: Insert the radar module into base board radar connector.



Step 3: Close the support clip locker



Step 4: Place the card reader with radar inside your Port device

For example:

NOTE: The marking label oft he host appliance of the present radar module must contains the following inscription:
“Contains FCC ID: XFIPORTRADARVER1”

Application Notes

Sensitivity and Maximum Range

The values indicated here are intended to give you a ’feeling’ of the attainable detection range with this module. It is not possible to define an exact RCS (radar cross section) value of real objects because reflectivity depends on many parameters.

Please note, that range values also highly depend on the performance of signal processing, environment conditions (i.e. rain, fog), housing of the module and other factors.
For simple detection purposes (security applications e.g.) without the need of speed measurements, range may be enhanced by further reducing the IF bandwidth. With 250Hz bandwidth and a simple comparator, we get already a 25m detection range.

FCC in formations:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
Changes or modifications not expressly approved by the manufacturer could void the user’s authority to operate the equipment

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency

energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.

FCC ID : XFIPORTRADARVER1