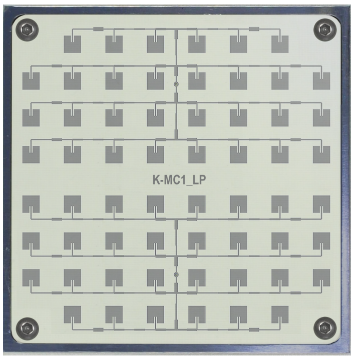
K-MC1_LP RADAR TRANSCEIVER

Datasheet

Features

- LOW CURRENT 24 GHz short range transceiver
- 8mA @ 3.3V at same performance as K-MC1
- 3.3V … 5V supply
- Less than 30mW power consumption
- High sensitivity, with integrated RF/IF amplifier
- Dual 30 patch antenna
- Buffered I/Q IF outputs
- Beam aperture 25°/12°
- Slim 6mm thickness construction



Applications

- Battery operated equipment
- Traffic supervision
- Object speed measurement systems
- Industrial sensors

Description

K-MC1_LP is a low current, doppler module with an asymmetrical narrow beam for long distance sensors. It is ideally suited for traffic applicatons.
This module includes a RF low noise amplifier and two 47dB IF pre-amplifiers for both I and Q channels. The need for external analogue electronics will be significantly reduced by this feature.

K-MC1_LP needs 10 times less current than our standard K-MC1 sensor and works from 3.3V or 5V power supplies.
An extremely slim construction with only 6mm depth gives you maximum flexibility in your equipment design.
Powerful starter kits with signal conditioning and visualization are available.

Blockdiagram

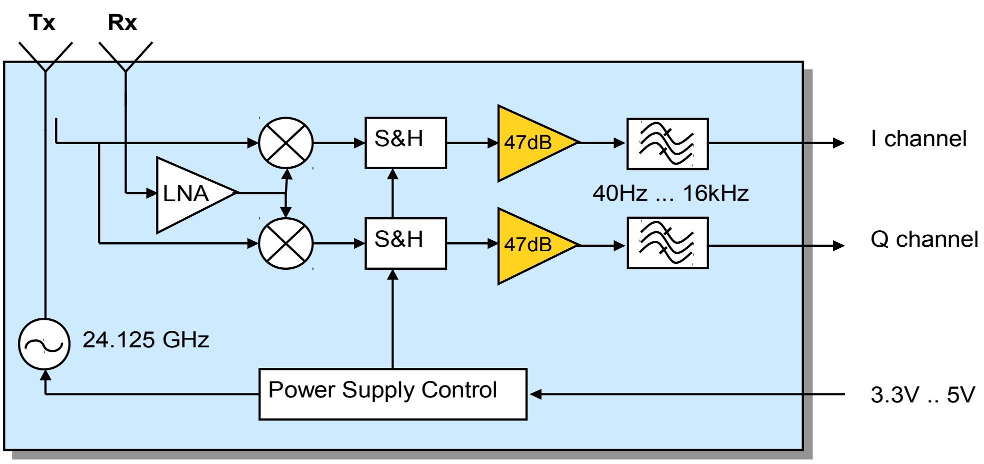


Fig. 1: K-MC1_LP Blockdiagram

Characteristics

Parameter	Conditions / Notes	Symbol	Min	Typ	Max	Unit
Operating conditions						
Supply voltage		V_{cc}	3.15		6.0	V
Supply current	Module enabled (Pin 1 = V_{IL})	I_{cc}		7.5	9	mA
Operating temperature		T_{op}	-20		+80	°C
Storage temperature		T_{st}	-20		+80	°C
Transmitter						
Transmitter frequency	U_{VCO}= 5V, T_{amb}=-20°C .. +60°C	f_{TX}	24.050	24.150	24.250	GHz
Frequency drift vs temp.	V_{cc}=5.0V, -20°C .. +60°C Note 1	Δf_{TX}		-1.0		MHz/°C
Output power	EIRP peak power	P_{TX}	+16	+18	+20	dBm
Transmitter duty cycle	internally generated	d		1		%
Spurious emission	According to ETSI 300 440	P_{spur}			-30	dBm
Receiver						
Antenna gain	F_{TX}=24.125GHz Note 2	G_{Ant}		18.5		dBi
LNA gain	F_{RX}=24.125GHz	G_{LNA}		10		dB
Mixer Conversion loss	f_{IF} =500Hz	D_{mixer}		-1		dB
Receiver sensitivity	f_{IF} =500Hz, B=1kHz, S/N=6dB	P_{RX}		-122		dBm
Overall sensitivity	f_{IF} =500Hz, B=1kHz, S/N=6dB	D_{system}		-140		dBc
IF output						
IF output impedance		R_{IF_AC}		100		Ω
IF Amplifier gain		G_{IF_AC}		47		dB
I/Q amplitude balance	f_{IF} =500Hz, U_{IF}=100mV_{pp}	ΔU_{IF}		3		dB
I/Q phase shift	f_{IF} =500Hz, U_{IF}=100mV_{pp}	φ	80	90	100	°
IF frequency range	-3dB Bandwidth	f_{IF_AC}	40		15k	Hz
Spurious signals	Internal regulator @ 100kHz	V_{sp}			0.3	mVrms
IF noise voltage	f_{IF} =1kHz	$U_{IFnoise}$		35		µV/√Hz
	f_{IF} =1kHz	$U_{IFnoise}$		-89		dBV/Hz
IF output offset voltage	V_{cc} = 5V, _AC outputs	U_{os_AC}	1.0	1.5	2.0	V
Supply rejection	Rejection supply pins to _AC outputs, 500Hz	D_{supply}		-24		dB
Antenna						
Horizontal -3dB beamwidth	E-Plane	W_{φ}		12		°
Vertical -3dB beamwidth	H-Plane	W_{θ}		25		°
Horiz. sidelobe suppression		D_{φ}		-20		dB
Vert. sidelobe suppression		D_{θ}		-18		dB
Body						
Outline Dimensions	connector left unconnected			65*65*6		mm^3
Weight				50		g
Connector	Module side: AMP X-338069-8			8		pins

Note 1 Transmit frequency stays within 24.050 to 24.250GHz over the specified temperature range
Note 2 Theoretical value, given by Design

Antenna System Diagram

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

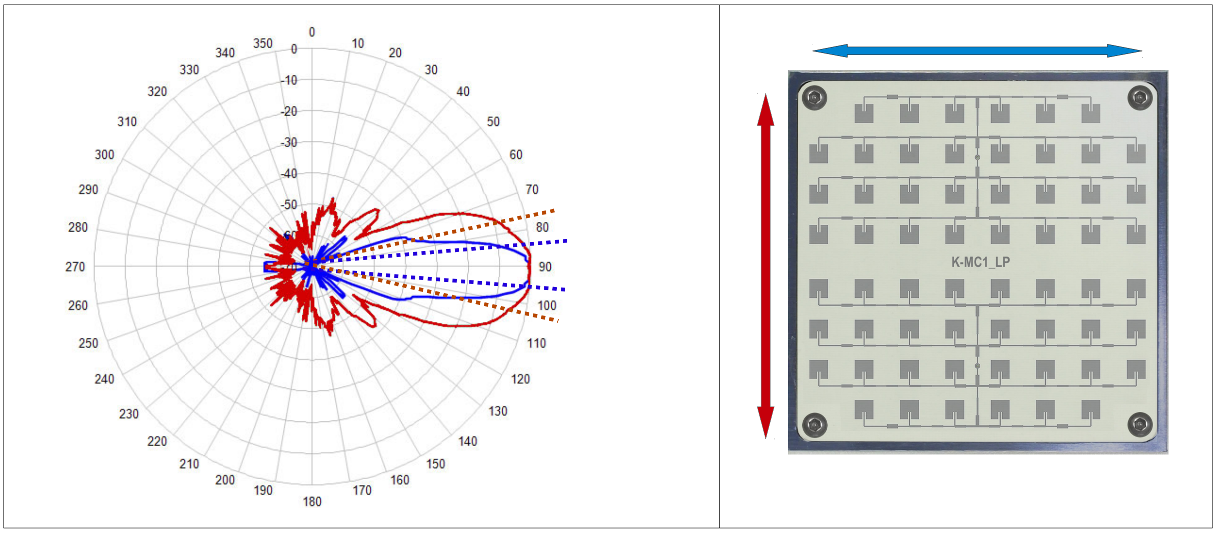
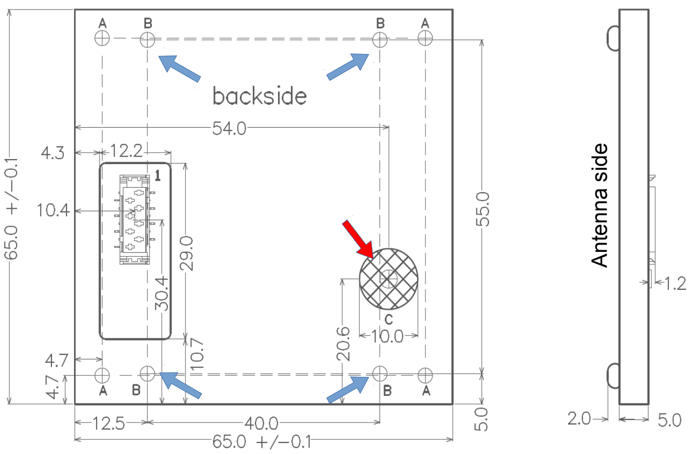


Fig. 2: Anntenna system diagram

Pin Configuration

Pin	Description	Typical Value
1	nc	
2	VCC	3.3V..5V supply
3	GND	0V supply
4	IF output Q	
5	IF output I	
6	nc	
7	nc	
8	nc	

Outline Dimensions



Mounting instruction

Mount from back side using thread marked with **B**:
M2.5 screws, screw depth < 3.5mm

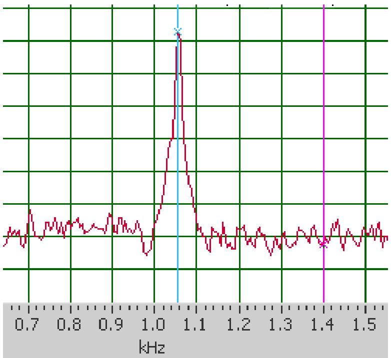
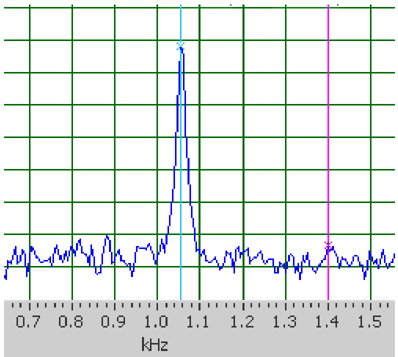
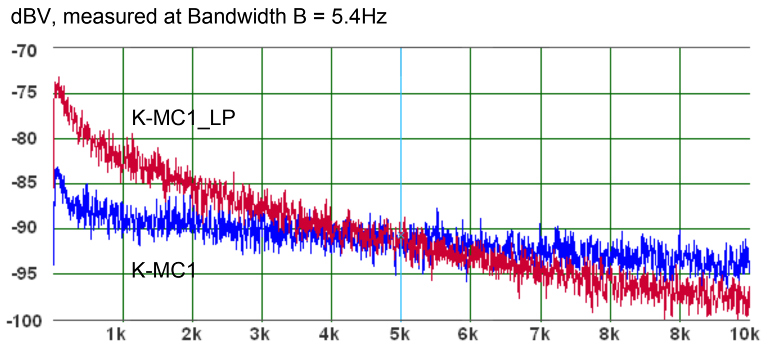
Keep out zone C (tuning srcew)

K-MC1_LP modules must not be used without screws in A.

Fig. 3: Mechanical dimensionsApplication Notes

Application Notes

Main Differences K-MC1_LP vs K-MC1

	K-MC_LP	K-MC1
Current consumption (typ.)	7.5mA	70mA
Supply Voltage	3.15V ... 6V	4.75V … 5.25V
VCO Input (FMCW, FSK)	not available	yes
IF highspeed DC output	not available	yes
IF output DC offset (typ.)	1.5V	2.5V
RSW rapid sleep wakeup	not available, not necessary	yes (sleep current typ 7mA)
Sensitivity (typical)	-140dBc	-141dBc
IF noise voltage (typ. @1kHz)	- 91dBV/Hz	-96dBV/Hz
SNR Signal-to-noise ratio same signal for comparison K-MC1_LP has similar sensitivity as K-MC1 despite the higher noise level.	 5dB/div → SNR = 32dB	 5dB/div → SNR = 33dB
Worst case 1/f Noise comparison Low current technology of K-MC1_LP requires high sensitive mixer diodes in order to get same sensitivity as K-MC1. Higher 1/f noise is caused by these diodes and by aliasing of internal switching noise. Please note, that higher K-MC1_LP noise does not significantly affect the SNR (signal-to-noise ratio). See diagrams above for SNR.	 K-MC1 sample with minimal noise floor and K-MC1_LP sample with high noise floor	

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. The RCS variations however influence the maximum range only by $\sqrt[4]{\sigma}$.

Maximum range for Doppler movement depends mainly on:

- Module sensitivity	S:	-140dBc (@1kHz IF Bandwidth)
- Carrier frequency	f_0:	24.125GHz
- Radar cross section RCS ("reflectivity") of the object	σ[1)]:	1m² approx. for a moving person >50m² for a moving car

[1)] RCS indications are very inaccurate and may vary by factors of 10 and more.

The famous "Radar Equation" may be reduced for our K-band module to the following relation:

$$r = 0.0167 \cdot 10^{\frac{-s}{40}} \cdot \sqrt[4]{\sigma}$$

Using this formula, you get an indicative detection range of
> 50 meters for a moving person
> 140 meters for a moving car

Please note, that range values also highly depend on the performance of signal processing, environment conditions (i.e. rain), housing of the module and other factors.

Datasheet Revision History

Version	Date	Changes
0.9	12-Nov-2013	preliminary release
1.0	02-Nov-2018	Changed footer to new address