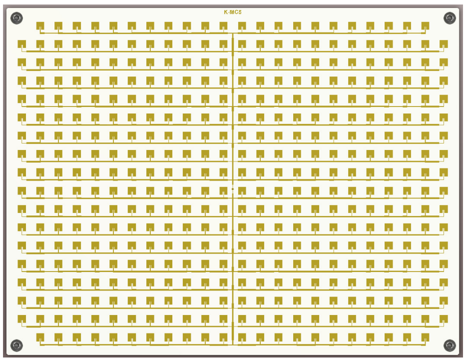
K-MC5_LP RADAR TRANSCEIVER

PRELIMINARY Datasheet

Features

- LOW CURRENT 24 GHz short range transceiver
- Very narrow beam aperture 5.0° x 6.5°
- 3.3V … 6V supply
- Less than 30mW power consumption
- Buffered I/Q outputs with integrated IF amplifier
- Wide temperature operating range
- Single 428 patch antenna
- Slim 10mm thickness construction



Applications

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

Description

K-MC5_LP is a low power consuming Doppler module with a very narrow beam for medium 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-MC5_LP contains power safe circuitry resulting in only 8mA at a wide range of 3.3V to 6V supply voltage.
An extremely slim construction with only 10mm depth gives you maximum flexibility in your equipment design.
Powerful starter kits with signal conditioning and visualization are available.

Blockdiagram

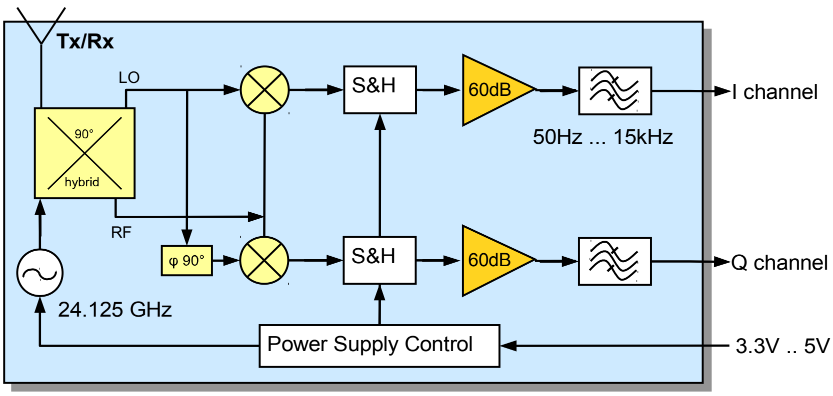


Fig. 1: K-MC5_LP Symbolic Blockdiagram

Characteristics

Parameter	Conditions / Notes	Symbol	Min	Typ	Max	Unit
Operating conditions						
Supply voltage		V_{cc}	3.15	4.5	6.0	V
Supply current	Module enabled (Pin 1 = V_{IL})	I_{cc}		8.5	15	mA
Operating temperature		T_{op}	-40		+85	°C
Storage temperature		T_{st}	-40		+85	°C
Transmitter						
Transmitter frequency	U_{VCO}= 5V, T_{amb}=-40°C .. +85°C	f_{TX}	24.000	24.150	24.250	GHz
Frequency drift vs temp.	V_{cc}=5.0V, -20°C .. +60°C Note 1	Δf_{TX}		-0.7		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}		25		dBi
Mixer Conversion loss	f_{IF} =500Hz	D_{mixer}		-10		dB
Receiver sensitivity	f_{IF} =500Hz, B=1kHz, S/N=6dB	P_{RX}		-113		dBm
Overall sensitivity	f_{IF} =500Hz, B=1kHz, S/N=6dB	D_{system}		-135		dBc
IF output						
IF output impedance		R_{IF_AC}		100		Ω
IF Amplifier gain		G_{IF_AC}		60		dB
I/Q amplitude balance	f_{IF} =500Hz, U_{IF}=100mV_{pp}	ΔU_{IF}		2		dB
I/Q phase shift	f_{IF} =500Hz, U_{IF}=100mV_{pp}	φ	60	90	120	°
IF frequency range	-3dB Bandwidth	f_{IF_AC}	50		15k	Hz
Spurious signals	Internal regulator @ 100kHz	V_{sp}			0.3	mVrms
IF noise voltage	f_{IF} =1kHz	$U_{IFnoise}$		44		µV/√Hz
	f_{IF} =1kHz	$U_{IFnoise}$		-87		dBV/Hz
IF output offset voltage	V_{cc} = 5V, _AC outputs	U_{os_AC}	1.0	1.5	2.0	V
Supply rejection	to IF output @500Hz	D_{supply}		-22		dB
Antenna						
Horizontal -3dB beamwidth	E-Plane	W_{φ}		5.0		°
Vertical -3dB beamwidth	H-Plane	W_{θ}		6.5		°
Horiz. sidelobe suppression		D_{φ}		-18		dB
Vert. sidelobe suppression		D_{θ}		-16		dB
Body						
Outline Dimensions	connector left unconnected			186x143 x10		mm^3
Weight				210		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

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Antenna System Diagram

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

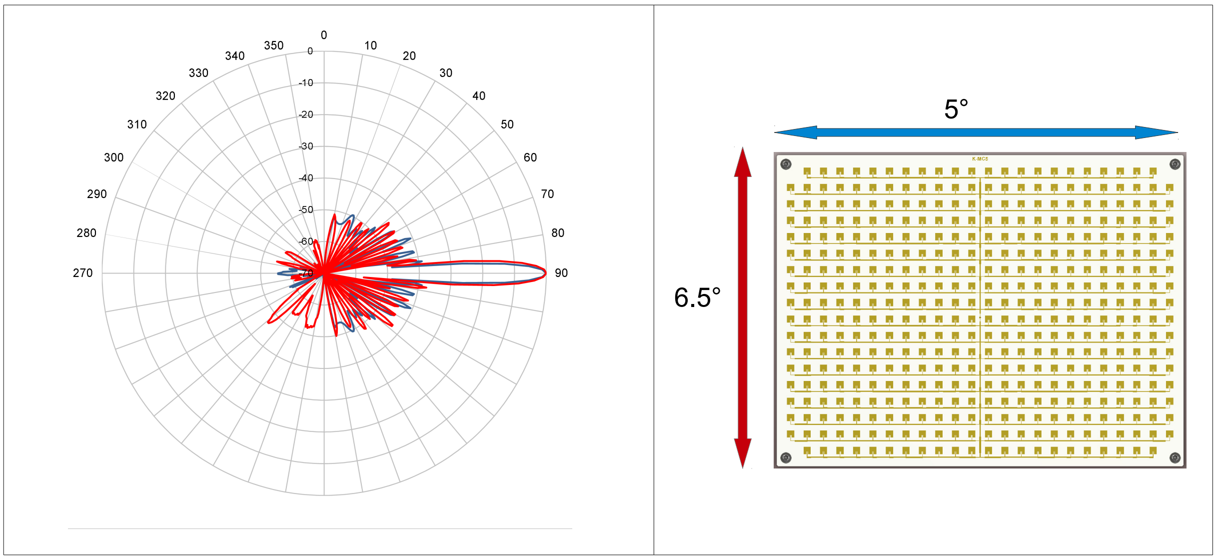

Fig. 2: Anntenna system diagram

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

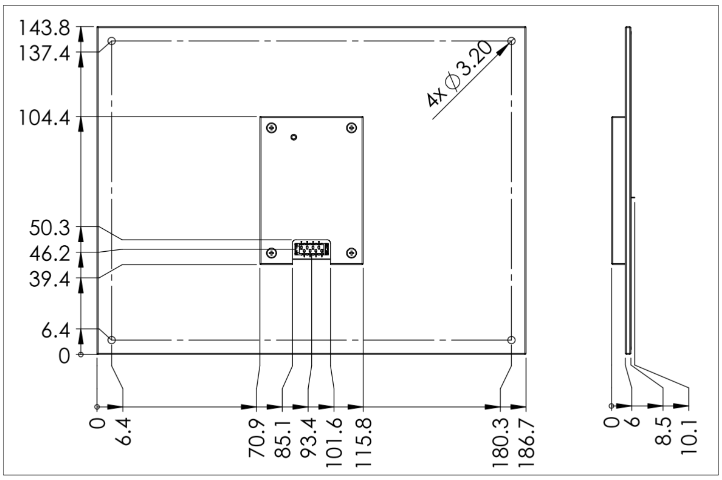

Fig. 3: Mechanical dimensions

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

Maximum range for Doppler movement depends mainly on:

- Module sensitivity	S:	-135dBc (@1kHz IF Bandwidth)
- Carrier frequency	f_0:	24.125GHz
- Radar cross section RCS ("reflectivity") of the object	σ[1]:	$1m^2$ approx. for a moving person
		$>50m^2$ 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
> 38 meters for a moving person
> 100 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

	Date	Changes
0.9	27-Oct-2014	preliminary release