 <b>HELLA</b> GmbH & Co KGaA. 59552 Lippstadt	Subject:	Date: 2023-05-08
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## 1) Details on one radar cycle for mode “CS12”:

Start of a radar cycle			
Antenna	Tx1	Tx2	Tx3
Chirp center frequency	78.0 GHz		
Chirp bandwidth	1720 MHz		
Number of chirps	512		
Duration of a single chirp	33...37 $\mu$ s		
Phase offset for consecutive chirps (repeating)	0° / 0° / 0° / 0° / 0°...	0° / 90° / 180° / 270° / 0°...	0° / 180° / 0° / 180° / 0°...
Time slot with no emission	31...33 ms		
End of radar cycle			
Duration of radar cycle	50 ms		
Duty cycle	34...38 %		

Tx1, Tx2, Tx3 transmit simultaneously with identical frequency vs time but with different phase offset per chirp vs time according to the code-based MIMO principle. As a result, in the far-field after linear superposition a time and angle dependent transmit power results.


## 2) Details on one radar cycle for mode “CS13” (EOL / service mode):

Start of a radar cycle			
Antenna	Tx1	Tx2	Tx3
Chirp center frequency	78.0 GHz		
Chirp bandwidth	630 MHz		
Number of chirps	512		
Duration of a single chirp	33 $\mu$ s		
Phase offset for consecutive chirps (repeating)	0° / 0° / 0° / 0° / 0°...	0° / 90° / 180° / 270° / 0°...	0° / 180° / 0° / 180° / 0°...
Time slot with no emission	33 ms		
End of radar cycle			
Duration of radar cycle	50 ms		
Duty cycle	34 %		

Tx1, Tx2, Tx3 transmit simultaneously with identical frequency vs time but with different phase offset per chirp vs time according to the code-based MIMO principle. As a result, in the far-field after linear superposition a time and angle dependent transmit power results.

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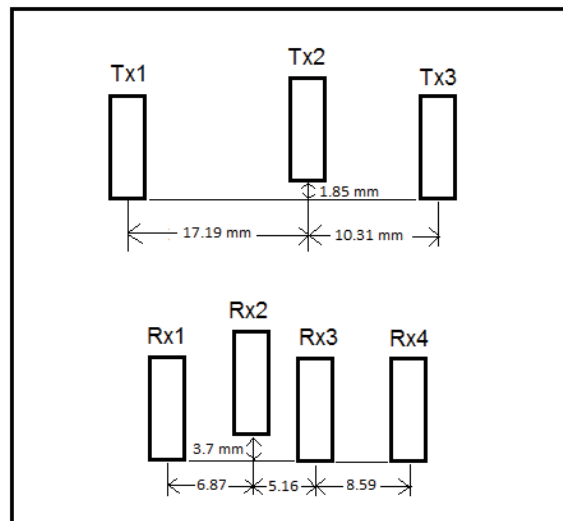
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## Technical Data

Supply voltage	+9 V ... +18 V
Power consumption	Typ. 4.3 W
Operating temperature range	-40°C ... +85°C
Operating frequency range	77000 MHz ... 79000 MHz
Modulation bandwidth	1720 MHz (CS12), 630 MHz (CS13)
Modulation	FMCW (fast chirps) plus phase-coding
Antenna feed power	10 dBm (peak), 4 dBm (average)
Antenna type	Waveguide slot array
Transmit antenna Tx1 gain	11 dBi
Transmit antenna Tx2 gain	11 dBi
Transmit antenna Tx3 gain	11 dBi
Rated maximum transmission power EIRP	20 dBm (average), 30 dBm (peak)

Because of the simultaneous operation of all three transmitters with identical frequency, from outside of the radar sensor a single effective transmitter can be assumed with an effective gain of  $11 \text{ dBi} + 20 \log(3) = 20.5 \text{ dBi}$  for peak power and of  $11 \text{ dBi} + 10 \log(3) = 15.77 \text{ dBi}$  for average power.

## Additional antenna properties



View on Tx and Rx antennas inside the EUT. Each antenna has horizontal polarization.  
The vehicle connectors are on the left side.

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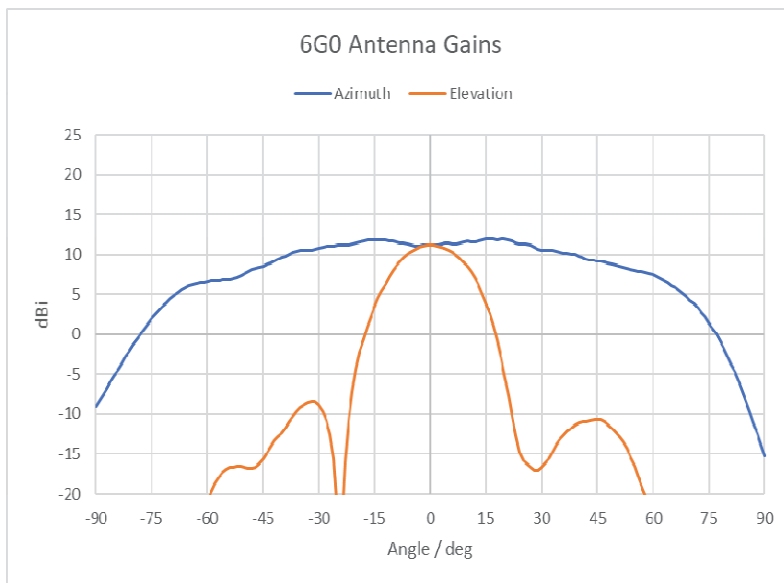


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**Tx1, Tx2 and Tx3 antenna characteristics in azimuth and in elevation. The peak gain is approx. 11 dBi.**

**Abbreviations**

ADC	Analog-to-digital converter
BPF	Band pass filter
FMCW	Frequency modulated continuous wave
IF	Intermediate frequency
RF	Radio frequency
Rx	Receive
Tx	Transmit
VCO	Voltage controlled oscillator
WD	Watch dog

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