Functional description

MARQUARDT

Technical Description

Remote control vehicle key
BR166

PN: B3333D (Basis)
PN: K3333D (Keyless Go)

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1.1 Operation of BASIC Key

1.1.1 Access permission with BASIC Key

The locking and drive permission system BR166 (3333.4/5) incorporates a function which enables the locking and unlocking of the doors. There are two separate buttons each one for lock and unlock the vehicle. All vehicles with a boot lid are equipped with a third button for unlocking the boot lid.
The key is provided with a fourth button to activate the “PANIC” function for vehicles intended for the US market.

The function is activated by pushing a button, the method of button pushing determines the function activated on the vehicle, e.g. prolonged pressure on the button initiates an IR comfort function.

If messages are discharged from the key, the access permission information is sent via radio waves (HF) and redundantly via infrared (IR) from the key to the vehicle. The so-called comfort signals are special functions which require visual contact with the vehicle. Upon pressing the button for an extended period, these signals are sent via IR signal only after the standard access permission message.

HF communication via 3-channel operation:

The access permission message is sent sequentially on 3 radio channels adjacent to one another within the permissible ISM band. The radio receiver installed within the vehicle is able to receive the message discharged from the key on all 3 channels, evaluate it and send an appropriate control message to the central locking system.

1.1.2 Drive permission with BASIC Key

After the key is pushed into the EZS (electronic ignition switch) a cryptographically, bidirectional communication by infrared light is initiated. As there is a successful authorization of the key the engine of the vehicle can be started.

1.2 Operation of KEYLESS GO Key

The KEYLESS Go key model is equipped with all of the BASIC model functions.

Additional the KEYLESS GO model only facilitates full utilisation of the drive permission system function on the vehicle without active operation of the key. This means that one can lock and unlock the vehicle (access permission) without operating the key and activate and deactivate the immobiliser (drive permission) without placing the key in the ignition switch. It is only necessary to carry the key in order to be identified as an authorised vehicle user.

In addition to the basic variant, the keyless go key is expanded to include an LF receiver component, comprising of inductive antennae which create the three spatial directions x, y and z, and an associated LF receiver ASIC. Additionally, the keyless go variant of the key is equipped with a special HF ASIC, which facilitates bidirectional HF communication.

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1.2.1 Access permission with keyless entry

The keyless access permission (keyless entry) is initiated by the vehicle user activating the vehicle door handle. This causes the vehicle to send an inductive wake up message. On receiving this, the key starts in active mode.
The vehicle now sends further unmodulated, inductive fields which enable the key to ascertain its position in relation to the vehicle on the basis of field strength measurements.
Bidirectional HF communication follows, in which cryptographically encrypted authentication data is transferred between the key and the vehicle.
If the key is outside the vehicle, the vehicle is locked or unlocked following transferral of the correct data.

1.2.2 Drive permission with keyless go

In principle, when activating the start/stop button for a keyless engine start, the same process runs as that described for access permission of the BASIC model. The difference here is that the key must be located inside the vehicle, but needs not to push into the EZS (electronic ignition switch).
The presence of the key inside the vehicle is verified on every 5km driven, and on driving away. The process that runs here is similar to the engine start process, although shorter.
The cryptographically encrypted authentication between key and vehicle is accomplished by a bidirectional RF communication.

1.2.3 LF / HF transferral

The inductive wake-up message is sent in a phase-modulated (PSK) format through the vehicle on the frequency 21.845 kHz with a data rate of 5.461 kBd.
With respect to bidirectional HF communications, these are processed in a frequency-modulated (FSK) format, in the ISM band on 433.92 MHz in Europe and 315 MHz in the USA. The rate of data transferral is 10 kBd.

1.2.4 Operating frequencies of HF transferral

1.2.5 1-channel

In 1-channel operation, the mid-frequency of the channel is:

ECE:	433.92 MHz
USA, Japan:	315.00 MHz

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1.2.5.1 3-channel

The following table shows the mid-frequency of the individual channels for each frequency band.

Channel name		Channel mid-frequency
Name	**Abbreviated ID**	
Channel 1	CH1	USA: 314.00 MHz ECE: 433.47 MHz
Channel 2	CH2	USA: 314.90 MHz ECE: 434.37 MHz
Channel 3	CH3	USA: 314.45 MHz ECE: 433.92 MHz

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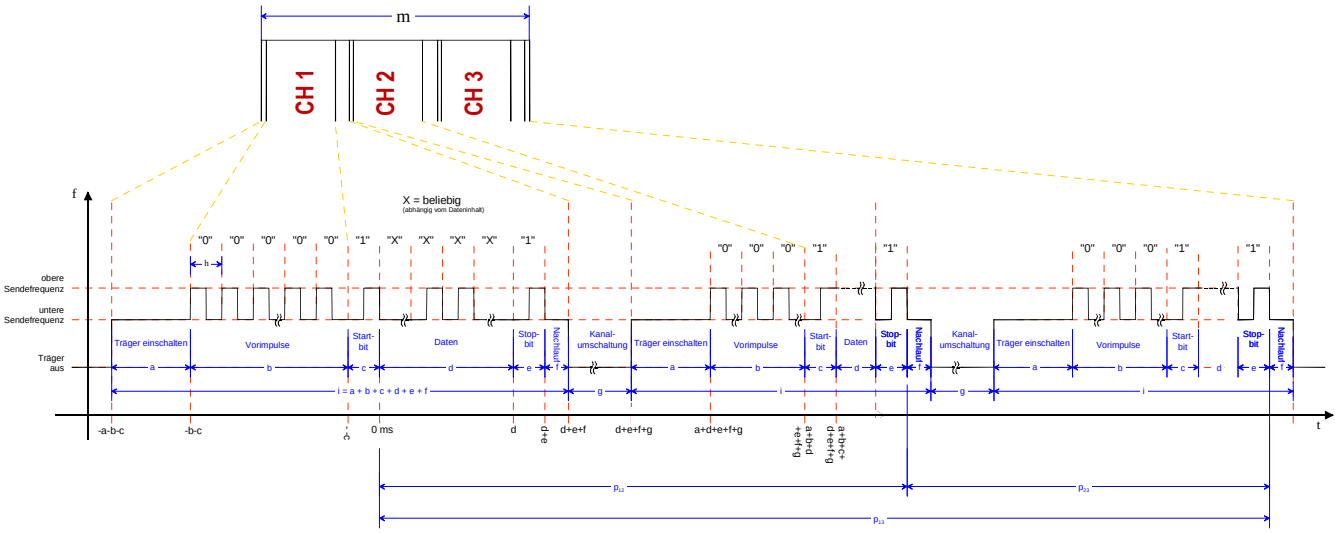
1.3 HF protocol

1.3.1 3-channel operation



Parameter	Beschreibung	Zeit	zul. Toleranz
a	Träger einschalten auf unterer Sendefrequenz	0,150ms	±50µs
b	Vorimpulse (550 Stück)	55,000ms	±550µs
c	Startbit	0,100ms	±1µs
d	Daten (120Bit =14Byte + 1Byte Checksumme)	12,000ms	±120µs
e	Stopbit	0,100ms	±1µs
f	Nachlauf	0,150ms	±50µs
g	Kanalumschaltung (Träger ausgeschaltet)	0,600ms	±50µs
h	Periodendauer eines Bit	0,100ms	±1µs
i	=a+b+c+d+e+f	67,500ms	±772µs
p_{12}	=d+e+f+g+a+b+c+d+e	80,200ms	±943µs
p_{23}	=f+g+a+b+c+d+e	68,100ms	±822µs
p_{13}	=p_{12}+p_{23}	148,300ms	±1.765µs
m	Funkprotokoll gesamt (=2*g+3*i)	203,700ms	±2.416µs

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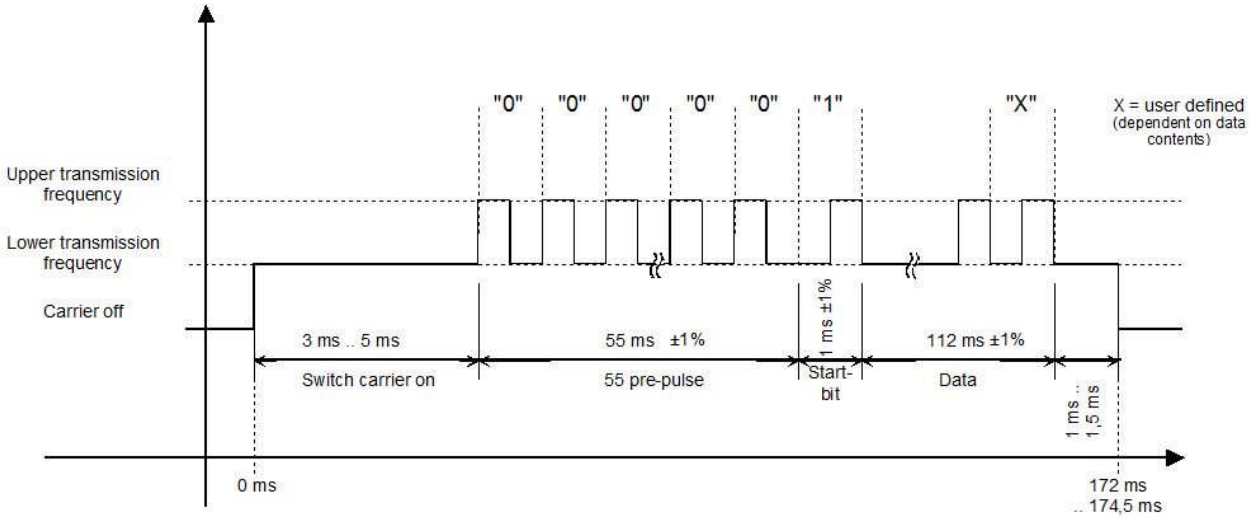
1.3.2 1-channel operation



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1.4 Technical data

1.4.1 General HF specification

- Operating frequencies, tolerance
  Single channel operation:
  f_{op1} = 315MHz (USA, Japan)
  f_{op2} = 433.92MHz (ECE)

  3-channel operation:
  f_{op1} = 314.00MHz / 314.45MHz / 314.9MHz (USA, Japan)
  f op2 = 433.47MHz / 433.92MHz / 434.37MHz (ECE)

  Temperature shift –20° to +65° C: +/-35ppm
  Ageing: +/-10ppm
  Remaining deviation after adjustment: +/-2ppm
  Voltage dependency and drift XTO: +/-3ppm
  Total tolerances remaining after
  adjustment of the initial frequency +/-50ppm

1.4.2 Specification of the HF transmitter

- Transmission power EIRP:
  ECE*: -14,4dBm….-22dBm
  USA/Canada ** -19.6dBm….-24dBm
  Japan(TELEC-T244)***: -19.6dBm….-24dBm

  * maximum transmission power limit Taiwan : 80.83dbµV/m at a distance of 3m.
  With isotopic propagation, the maximum transmission power is –14.4dBm.

  ** maximum transmission power limit according to FCC section15/Canada RSS-210:
  3.75…12.5mV/m in the 260-470MHz range at a distance of 3m
  At 315MHz the figure is 6.042mV/m, which relates to a transmission power of –19.63dBm with isotopic propagation.

  *** Use of the USA variant
  taken from the new TELEC-T244 Japanese standard
  Limit max. 25µW with transmission frequency of up to 315.25MHz, this relates to -16dBm
  Use of the USA variant

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- Settling time for the transmission frequency (PLL)

  $t_{StartUp}$ = 500µs
  t_{lock} ≤ 200µs with Δf = 600kHz with f_{error} ≤ 10kHz

- Modulation, baud rate:

  Single channel operation: 10 kBaud Manchester keyless go

  3-channel operation: 10 kBaud Manchester

  Tolerances: ≤ ±1.0 %

- Modulation type, range:

  2-FSK: +/-15kHz to +/-17kHz basic key
  2-FSK: +/-15kHz to +/-21kHz keyless go key

- Emitted interference
  - Harmonics & spurious

  315MHz: ≤: -49dBm @ ≤ 960MHz (*
  ≤: -41dBm @ > 960MHz (**

(* This reflects the limit of 200µV/m as per FCC section 15, with isotopic propagation
(**This reflects the limit of 500µV/m as per FCC section 15, with isotopic propagation

433.92MHz:
≤: -36dBm @ ≤ 1 GHz

≤: -30dBm @ > 1GHz

all frequency bands:
≤? -54dBm @ UKW & TV bands (EN300220)
47 -74MHz
87.5 –118MHz
174 –240MHz
470 – 862MHz

- Modulation quality:

  Overshoot: Max. 100% of the nominal value
  Max. duration of the overshoot:
  ≤ 6µs at 10 kBaud

  Build / fall times: 0 % to 100% nominal value:
  ≤ 6µs at 10 kBaud

The shift times are determined with a measuring receiver, the reception bandwidth of which lies as close as possible to the receiver in the application:

Remote Keyless Entry: BW_{Rx}= 600kHz
Keyless go operation: BW_{Rx}= 200kHz

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1.4.3 Specification of the HF Receiver (Keyless Go only)

Receiversensitivity with loop antenna P_{sens} : ≤ -75dBm

Receiver bandwidth: typ. 220kHz

LO- spurious < 1GHz: <-57dBm
LO- spurious > 1GHz: <-47dBm

1.4.4 Specification of the 3D-LF Receiver (Keyless Go only)

3 parallel X-/Y-/-Z-axis straight foreward LF-receiver with 3D inductive antenna

RX-frequency: 21,845 kHz
Rx-data rate: 5,461kBaud

History

V1.0	23.10.2009	First draft
V 1.01	09.11.2009	1.41/1.42 EEPROM at block diagram

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