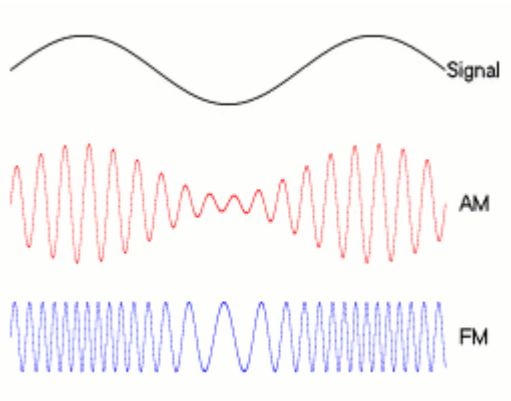
Porównanie technologii modulacji RFID oraz NFC.

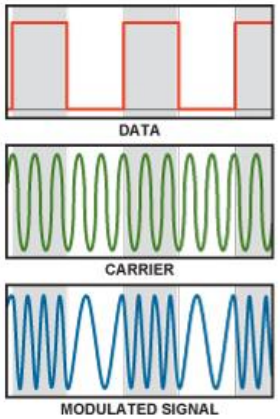
Punkty prezentacji

1. co to modulacja
2. po co modulacja
2. jak czytać skróty
2. co to nfc i rfid
3. modulacja w nfc
4. modulacja w rfid
5. Przykłady użycia

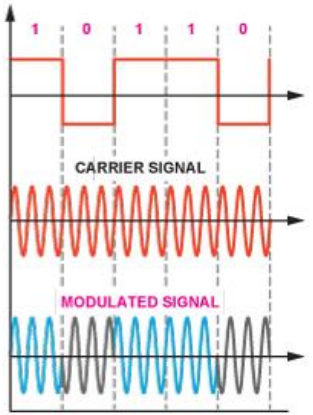
Co to modulacja?

Samorzutna (np. szumy) lub celowa zmiana parametrów sygnału.





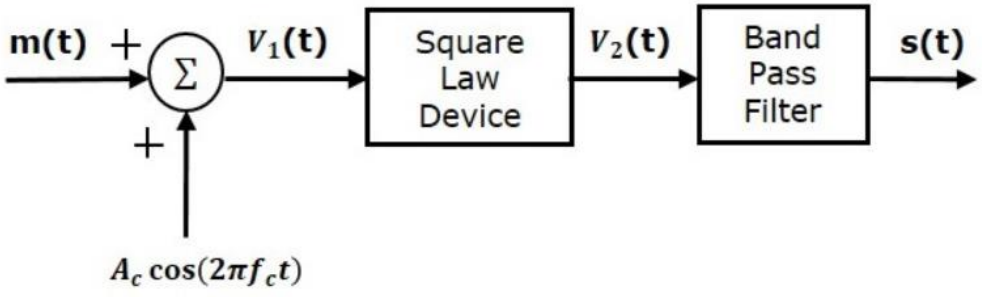
FSK

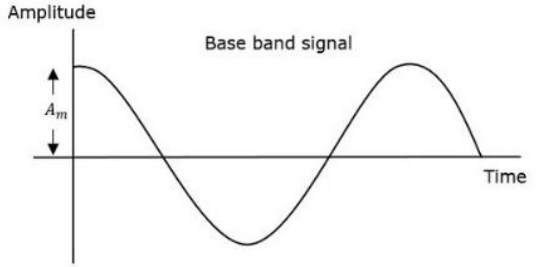


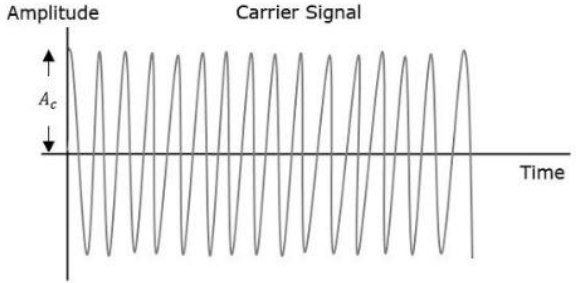
PSK

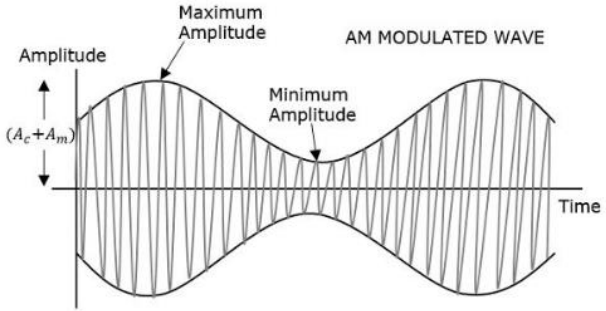
Co to modulacja? (cd.)

$$s(t) = A_c \left[1 + \left(\frac{A_m}{A_c}\right)\cos(2\pi f_m t)\right]\cos(2\pi f_c t)$$





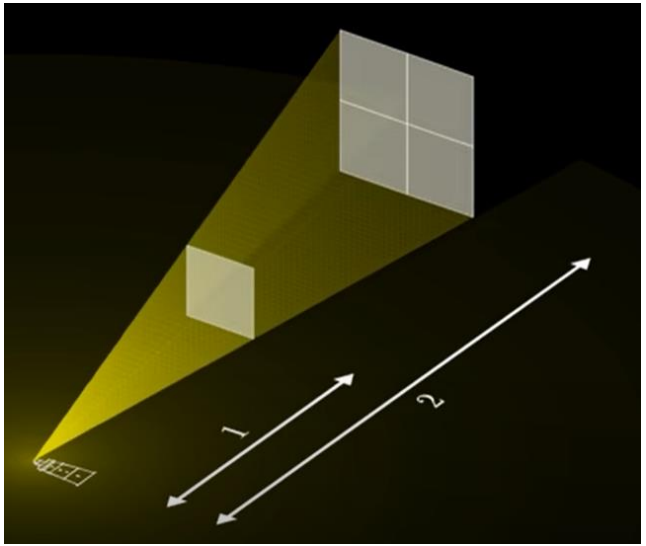


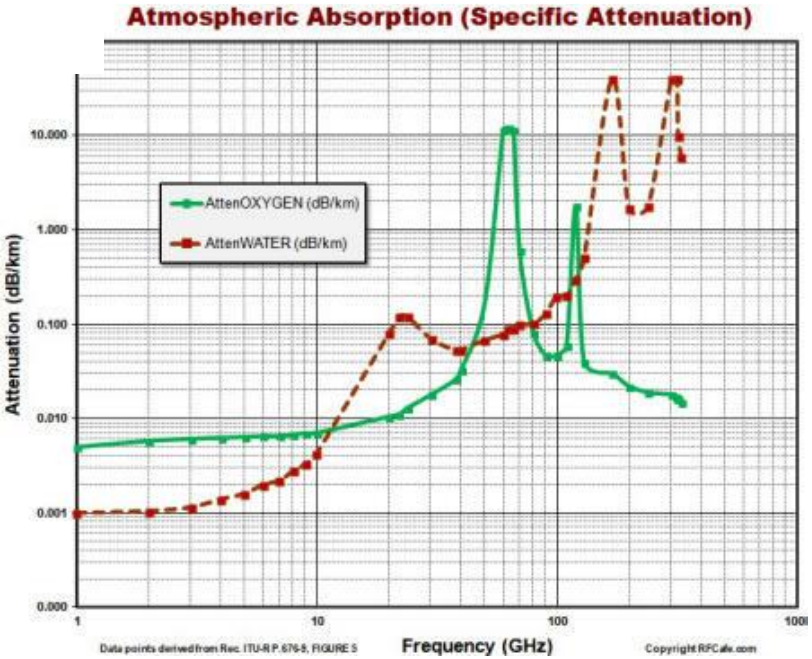


Po co modulacja

$$v = f\lambda$$

$$\frac{P_r}{P_t} = G_t G_r \left(\frac{\lambda}{4\pi R}\right)^2$$





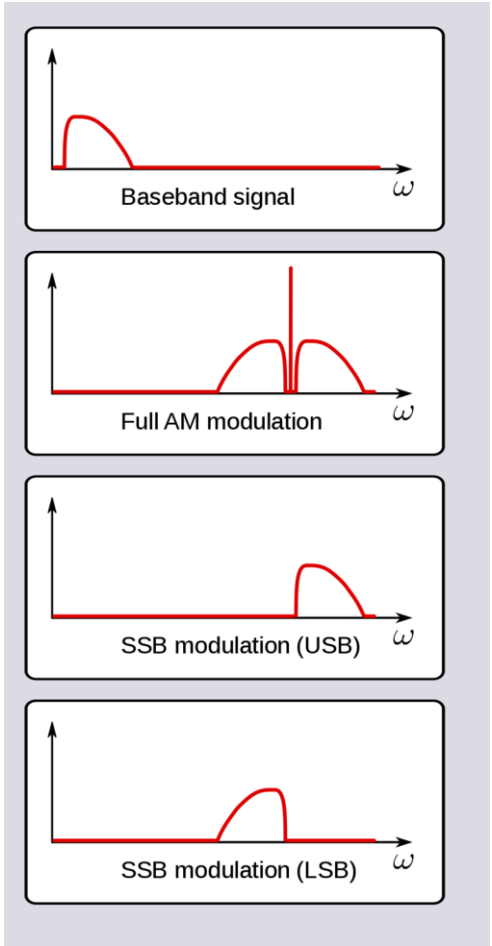
Jak czytać skróty.

AM- amplitude modulation

- DSB - SC (Double SideBand - Suppressed Carrier)
- SSB - US(Single SideBand-Upper Sideband)
- SSB - LS (Single SideBand-Lower Sideband)
- QAM (analog Quadrature Amplitude Modulation)

FM - frequency modulation

PM - phase modulation



Jak czytać skróty

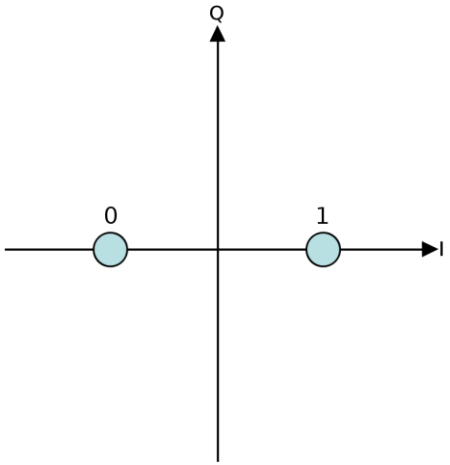
P S K - Phase Shif Keying

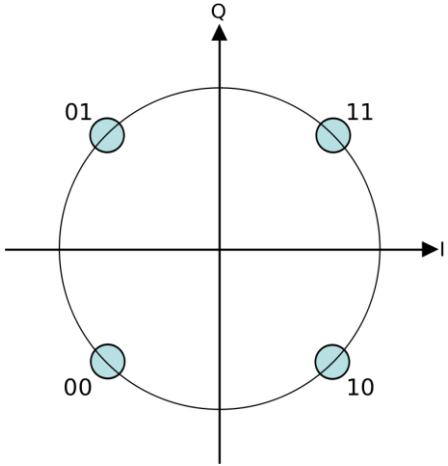
F S K - Frequency Shift Keying

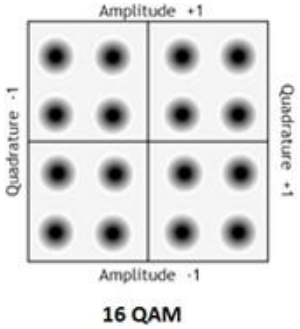
A S K - Amplitude Shift Keying

O O K- on-off -keying

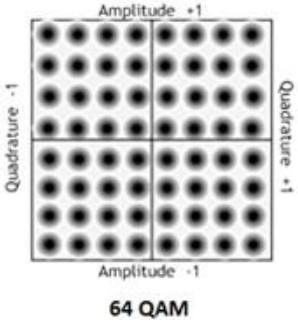
QAM - digital Quadrature Amplitude Modulation



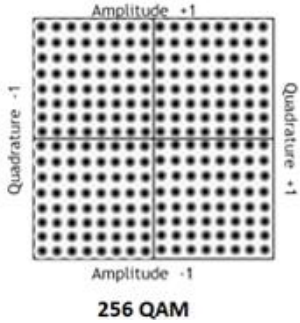




16 QAM

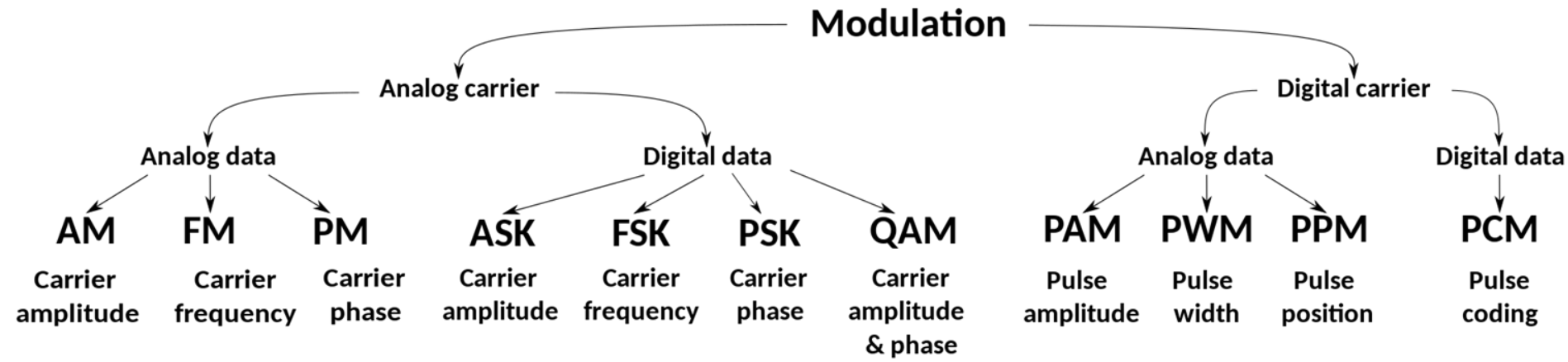


64 QAM



256 QAM

Jak czytać skróty (cd.)



Co to NFC i RFID

RFID jest technologią bezprzewodowej komunikacji pomiędzy czytnikiem a etykietą. Najczęściej TAG (etykieta) RFID jest zasilany przez czytnik bezprzewodowo za pomocą emitowanych fal radiowych. Nie jest to jednak regułą, ponieważ istnieją aktywne etykiety RFID wyposażone w zasilanie bateryjne.

NFC (ang. Near Field Communication) jest technologią bezprzewodowej komunikacji na bliskie odległości. NFC bazuje na rozwiązaniach technologicznych RFID, będąc jednocześnie autonomicznym standardem komunikacji bezprzewodowej.

Modulacja w nfc

NFC technology Type	Polling or Listening	NFC Modulation	NFC Coding
NFC-A	Polling	ASK 100% (Read explaination below)	Modified Miller
NFC-A	Listening	Load(ASK-Amplitude Shift Keying)	Manchester
NFC-B	Polling	ASK 10% (Read explaination below)	NRZ-L
NFC-B	Listening	Load (BPSK)	NRZ-L
NFC-F	Polling	ASK 10%	Manchester
NFC-F	Listening	Load modulation (ASK), read explaination below.	Manchester

Modulacja w nfc

ISO/IEC

NFC is standardized in ECMA-340 and ISO/IEC 18092. These standards specify the modulation schemes, coding, transfer speeds and frame format of the RF interface of NFC devices, as well as initialization schemes and conditions required for data collision-control during initialization for both passive and active NFC modes. They also define the transport protocol, including protocol activation and data-exchange methods. The air interface for NFC is standardized in:

ISO/IEC 18092 / ECMA-340—Near Field Communication Interface and Protocol-1 (NFCIP-1)[62]

ISO/IEC 21481 / ECMA-352—Near Field Communication Interface and Protocol-2 (NFCIP-2)[63]

Modulacja w nfc

ISO/IEC

NFC is standardized in ECMA-340 and ISO/IEC 18092. These standards specify the modulation

9.2.1.2 Modulation

See 8.1.2.1 of ISO/IEC 14443-2. During transmission, both the Initiator and the Target shall conform to PCD values. During reception, both the Initiator and the Target shall conform to PICC values.

ISO/IEC 18092 / ECMA-340—Near Field Communication Interface and Protocol-1 (NFCIP-1)[62]

ISO/IEC 21481 / ECMA-352—Near Field Communication Interface and Protocol-2 (NFCIP-2)[63]

Mdulacja w nfc

INTERNATIONAL STANDARD

ISO/IEC 14443-2

First edition
2001-07-01

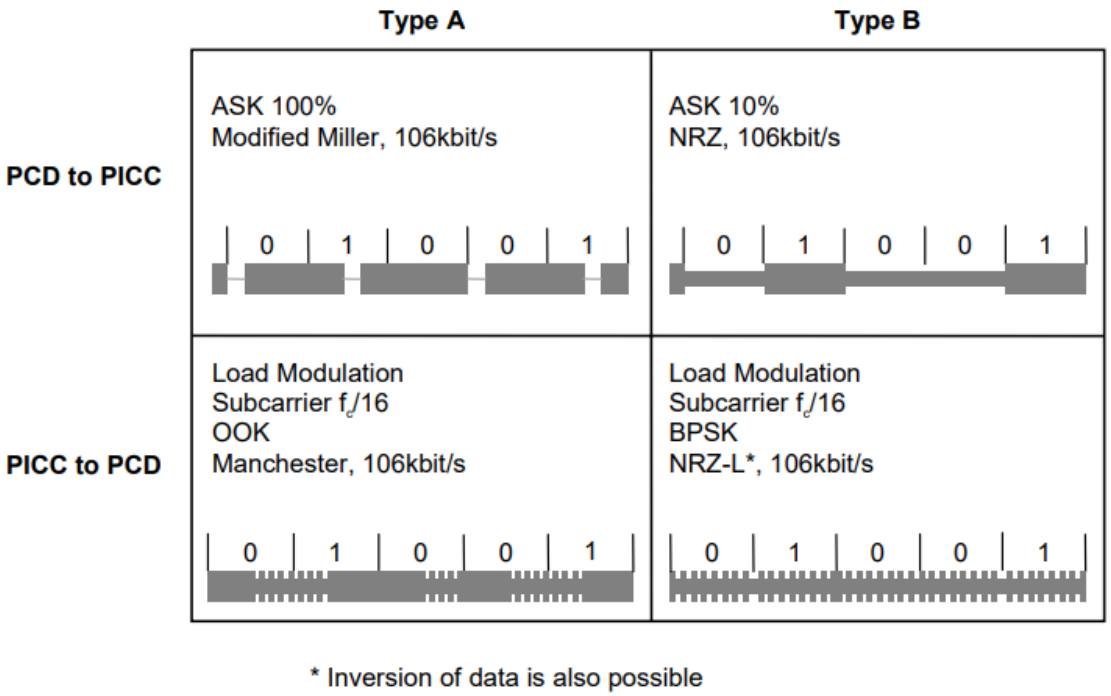
Identification cards — Contactless integrated circuit(s) cards — Proximity cards —

Part 2:
Radio frequency power and signal interface

Cartes d'identification — Cartes à circuit(s) intégré(s) sans contact — Cartes de proximité —

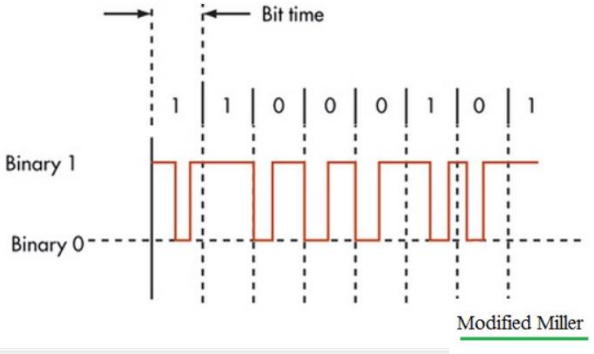
Partie 2: Puissance de la fréquence radio et interface du signal

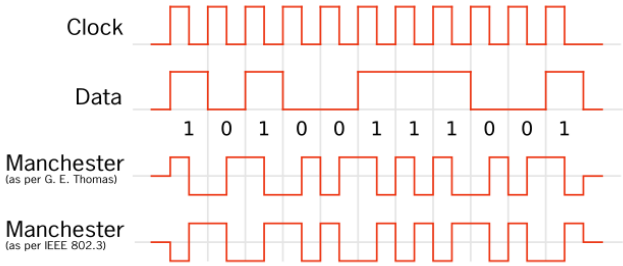
Modulacja w nfc



* Inversion of data is also possible

Figure 1 — Example communication signals for Type A and Type B interfaces





Modulacja w nfc

INTERNATIONAL STANDARD

ISO/IEC 14443-2

First edition
2001-07-01

8 Communication signal interface Type A

PCD	Proximity Coupling Device
PICC	proximity card or object

8.1 Communication PCD to PICC

8.1.1 Bit rate

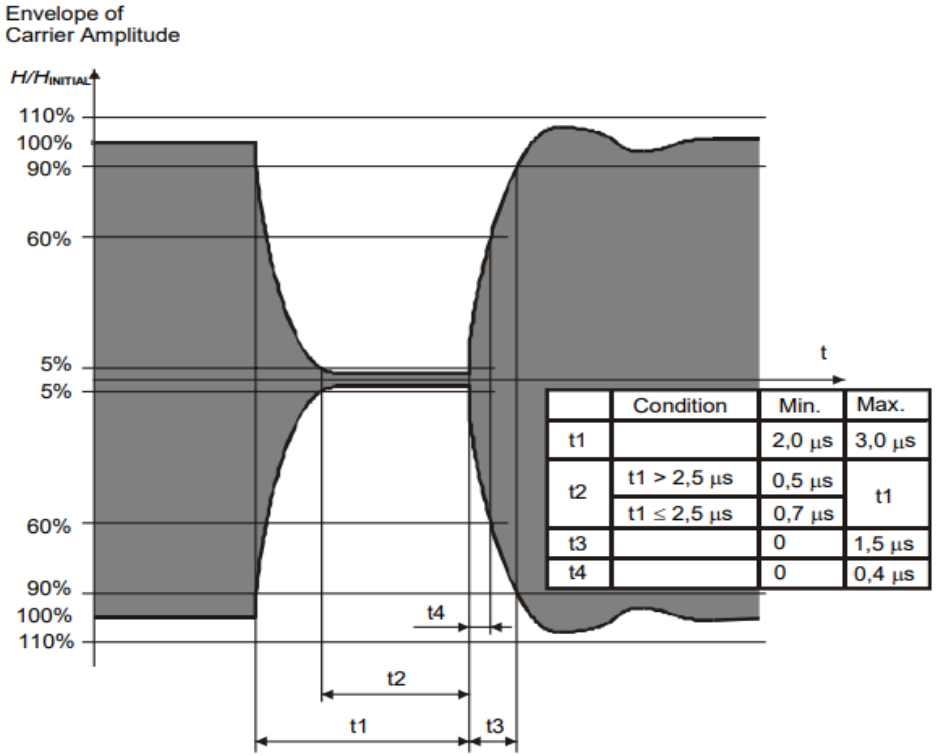
The bit rate for the transmission during initialization and anticollision shall be *fc*/128 (~106 kbit/s).

8.1.2 Modulation

Communication from PCD to PICC for a bit rate of *fc*/128 shall use the modulation principle of ASK 100% of the RF operating field to create a “Pause” as shown in figure 2.

The envelope of the PCD field shall decrease monotonically to less than 5% of its initial value $H_{INITIAL}$ and remain less than 5% for more than t2. This envelope shall comply to figure 2.

Modulacja w nfc



	Condition	Min.	Max.
t1		2,0 µs	3,0 µs
t2	t1 > 2,5 µs	0,5 µs	t1
	t1 ≤ 2,5 µs	0,7 µs	
t3		0	1,5 µs
t4		0	0,4 µs

Modulacja w nfc

8.1.3 Bit representation and coding
The following sequences are defined:

- sequence X: after a time of half the bit duration a "Pause" shall occur.
- sequence Y: for the full bit duration no modulation shall occur.
- sequence Z: at the beginning of the bit duration a “Pause” shall occur.
- The above sequences shall be used to code the following information:
- logic “1”: sequence X.
- logic “0”: sequence Y with the following two exceptions

  i) If there are two or more contiguous “0”s, sequence Z shall be used from the second “0” on.

  ii) If the first bit after a “start of frame” is “0”, sequence Z shall be used to represent
- this and any “0”s which follow directly thereafter.
- start of communication: sequence Z.
- end of communication: logic “0" followed by sequence Y.
- no information: at least two sequences Y.

8.2.4 Subcarrier modulation

Every bit period shall start with a defined phase relation to the subcarrier. The bit period shall start with the loaded state of the subcarrier.

The subcarrier is modulated using OOK with the sequences defined in 8.2.5.

8.2.5 Bit representation and coding

The following sequences are defined :

— sequence D: the carrier shall be modulated with the subcarrier for the first half (50%) of the bit duration.

— sequence E: the carrier shall be modulated with the subcarrier for the second half (50%) of the bit duration.

— sequence F: the carrier is not modulated with the subcarrier for one bit duration.

Bit coding shall be Manchester with the following definitions:

— logic “1”: sequence D

— logic “0”: sequence E

— start of communication: sequence D

— end of communication: sequence F

— no information: no subcarrier

9 Communication signal interface Type B

9.1 Communication PCD to PICC

9.1.1 Bit rate

The bit rate for the transmission during initialization and anticollision shall be nominally *fc*/128 (~106 kbit/s). Tolerance and bit boundaries are defined in ISO/IEC 14443-3.

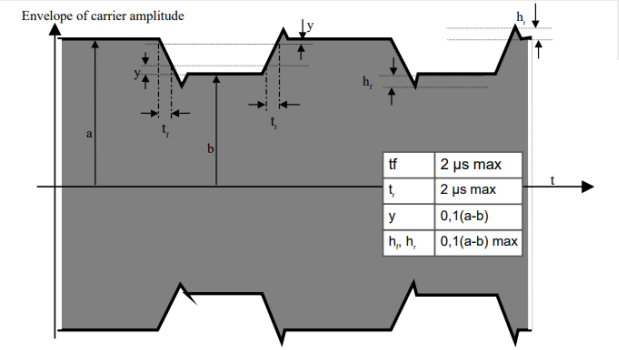


Figure 4 — Type B modulation waveform

9.1.2 Modulation

Communication from PCD to PICC shall use the modulation principle of ASK 10% of the RF operating field.

The modulation index shall be between 8% and 14%.

The modulation waveform shall comply to figure 4. The rising and falling edges of the modulation shall be monotonic.

Modulacja w rfid

Band	Regulations	Range	Data speed	ISO/IEC 18000 section	Remarks	Approximate tag cost in volume (2006)
LF: 120–150 kHz	Unregulated	10 cm (4 in)	Low	Part 2	Animal identification, factory data collection	US$1
HF: 13.56 MHz	ISM band worldwide	0.1–1 m (4 in – 3 ft 3 in)	Low to moderate	Part 3	Smart cards (ISO/IEC 15693, ISO/IEC 14443 A, B), ISO-non-compliant memory cards (Mifare Classic, iCLASS, Legic, FeliCa ...), ISO-compatible microprocessor cards (Desfire EV1, Seos)	US$0.05 to US$5
UHF: 433 MHz	Short range devices	1–100 m (3–300 ft)	Moderate	Part 7	Defense applications, Underground Miner Tracking with active tags	US$5
UHF: 865–868 MHz (Europe) 902–928 MHz (North America)	ISM band	1–12 m (3–40 ft)	Moderate to high	Part 6	EAN, various standards; used by railroads[24]	US$0.04 to US$1.00 (passive tags)
microwave: 2450–5800 MHz	ISM band	1–2 m (3–7 ft)	High	Part 4	802.11 WLAN, Bluetooth standards	US$25 (active tags)
microwave: 3.1–10 GHz	Ultra wide band	up to 200 m (700 ft)	High	Not defined	Requires semi-active or active tags	US$5 projected
mm-wave: 24.125 GHz [25][26][27]	ISM band worldwide	10–200 m (30–700 ft)	High	Not defined	Requires semi-passive tags. Uses retrodirective backscatter approaches to achieve extended ranges	US$10 projected

Przykłady użycia

ISO 14223

ISO 11784

ISO 11785

Protocol	**Full duplex (FDX or FDX-B)**	**Half duplex (HDX)**
Modulation	ASK	FSK
Frequency	129-133.2 kHz	124.2 kHz=1
	135.2-139.4 kHz	134.2 kHz=0
Channel code	Differential biphase (DBP)	None
Symbol time	0.23845 ms	0.1288 ms 1
		0.1192 ms 0
Telegram (bit)	128	112

Pytania?

Dziękuje za uwagę!