
MIL-STD-1553B Notice2
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# 개 요

- Military Standard 통신 규약
- Digital Internal Time Division Command/Response Multiplex Data Bus
- 개정 이력

  - 최초 규정 : 1973 년
  - MIL-STD-1553**A** : 1975 년
  - **MIL-STD-1553B** : 1978 년
  - **MIL-STD-1553B_NOTICE2** : 1986 년

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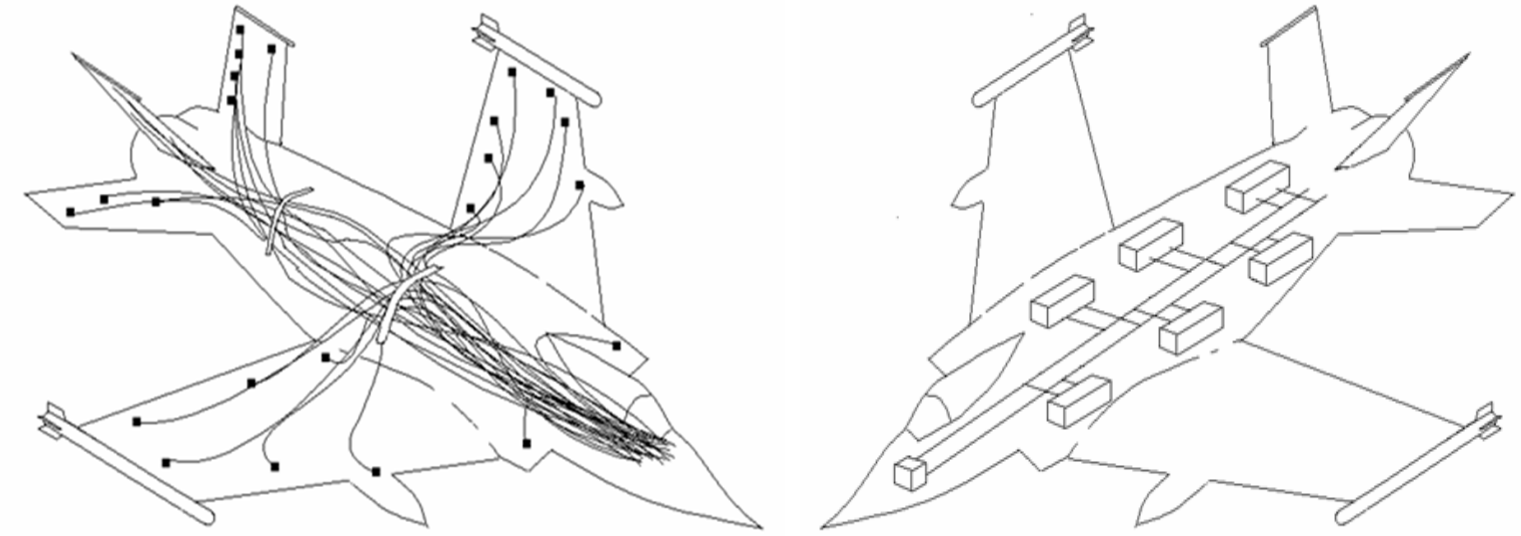
# 장점

- 시분할 다중전송방식으로 Cable 수, H/W 감소



- Redundancy( A, B 채널)

# 적용 사례

- Fighter Jets(F-14, F-16)
- Military Helicopters(Cobra)
- Tanks(M1A2)
- Ships(Aircraft Carriers, Battle Ships, Subs)
- Targeting Pods(Lantirn)
- Launcher Interface (Ground and Aircraft)
- Missile Interface
- Radar Interface
- Military and Commercial Satellites

# 기본 구성 요소

- Bus Controller (BC)
- Remote Terminal (RT)
- Bus Monitor (MT)
- Subsystem
- Terminal Hardware
  - 1553Transceiver, Encoder/Decoder
  - Subsystem
- Transmission Media & Accessories
- Twisted Shielded Pair Cable
- Terminator
- Coupler
- Connector

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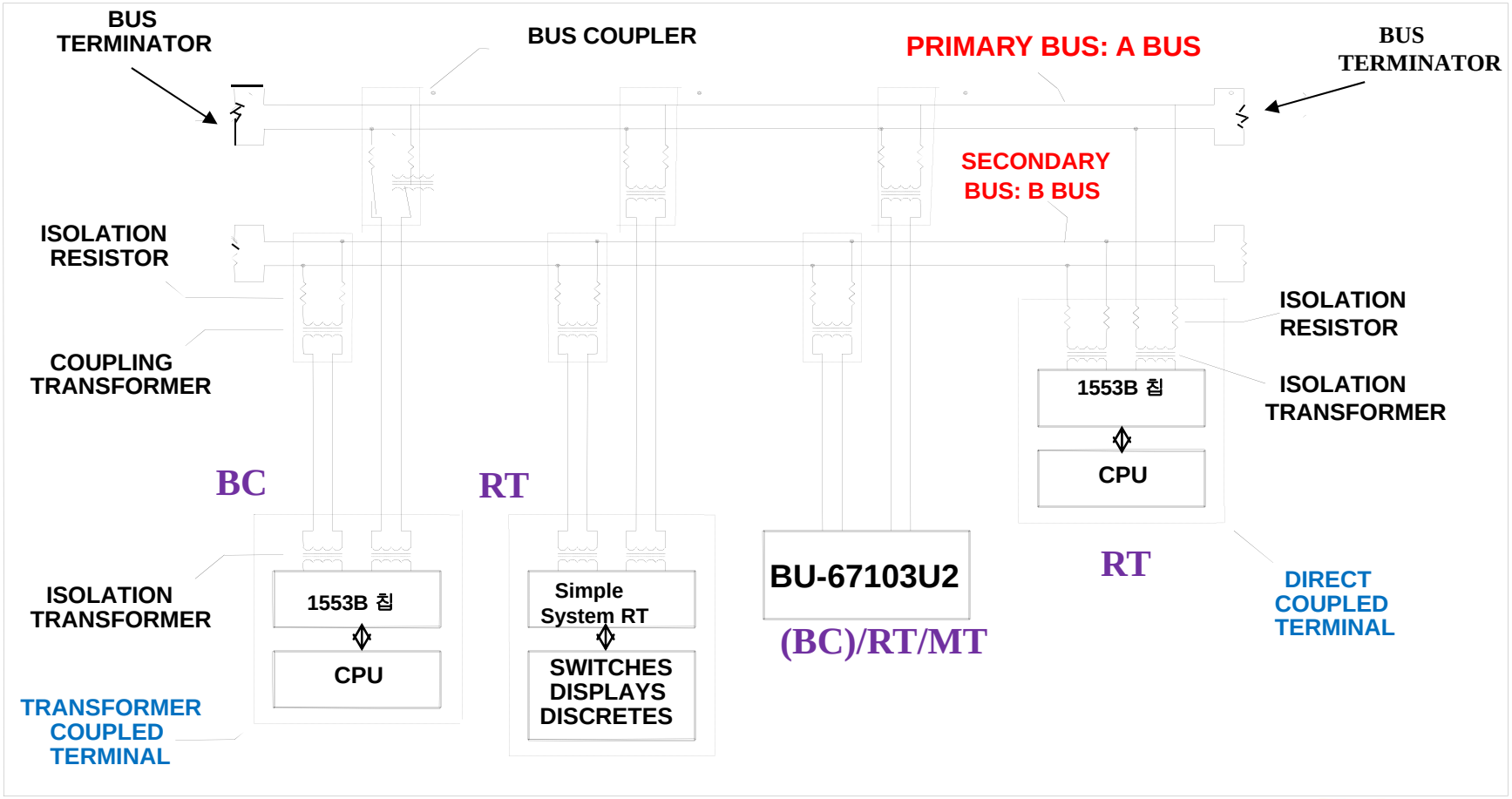
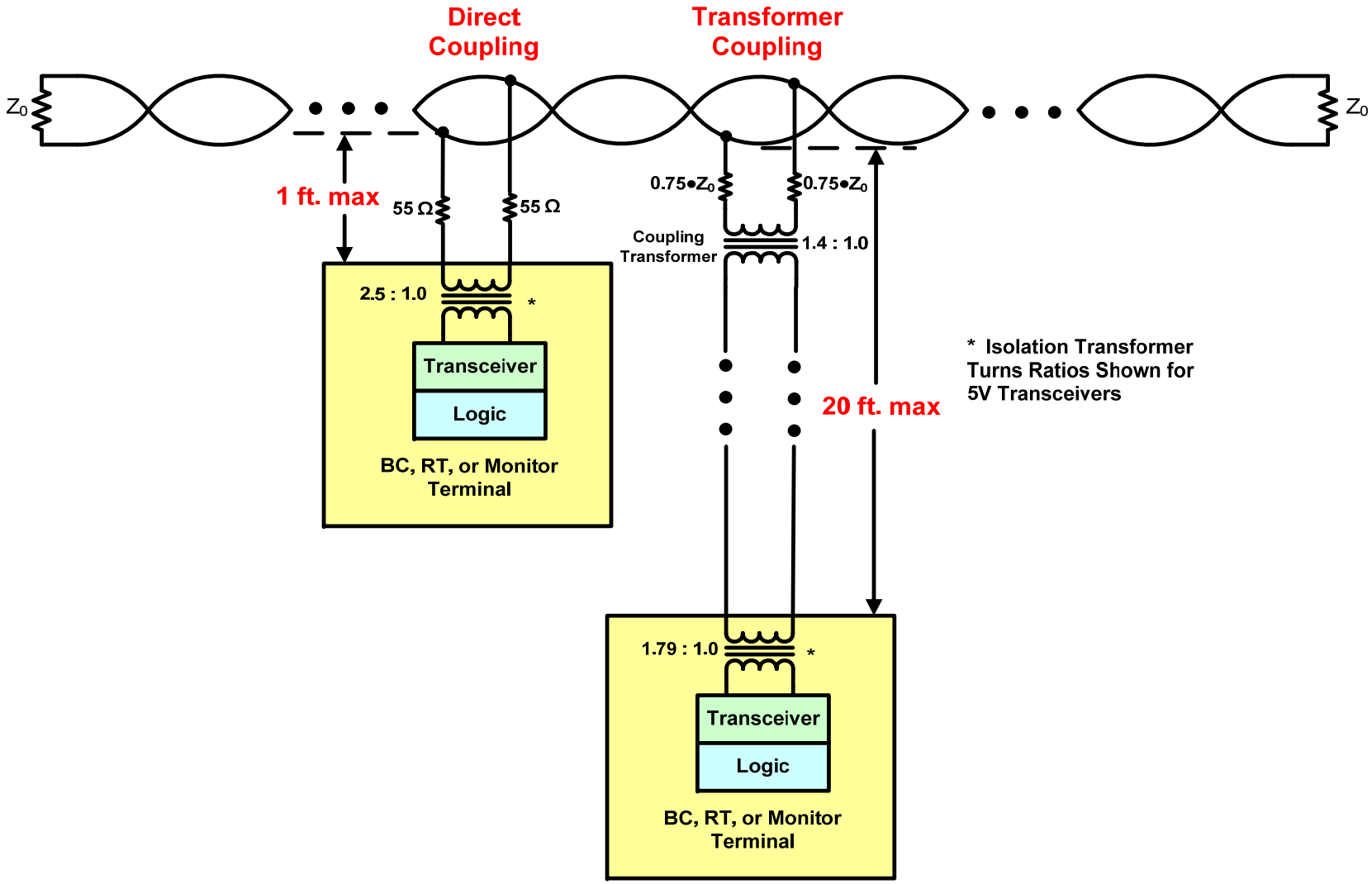
# 물리적 구성


BUS TERMINATOR
BUS COUPLER
PRIMARY BUS: A BUS
BUS TERMINATOR
SECONDARY BUS: B BUS
ISOLATION RESISTOR
COUPLING TRANSFORMER
ISOLATION RESISTOR
ISOLATION TRANSFORMER
1553B 칩
CPU
BC
RT
RT
ISOLATION TRANSFORMER
1553B 칩
CPU
Simple System RT
SWITCHES DISPLAYS DISCRETES
BU-67103U2
(BC)/RT/MT
DIRECT COUPLED TERMINAL
TRANSFORMER COUPLED TERMINAL

# Bus Coupling and Voltages

*20.6 Direct coupled stubs. (4.5.1.5.2) Direct coupled studs shall not be utilized in Air Force avionics applications. .



# Transmission Media & Accessories(1/3)

- **Bus Terminator**
  - BUS의 양 끝단을 Impedence 78 Ohm 으로 종결 시키는 장비 ( 전기적 종결 목적 )
  - 파형 왜곡을 불러올 수 있는 신호의 반향으로 인한 효과를 최소화
  - Terminator 미사용시 통신 신호는 왜곡되어 간헐적인 통신 실패의 원인이 됨

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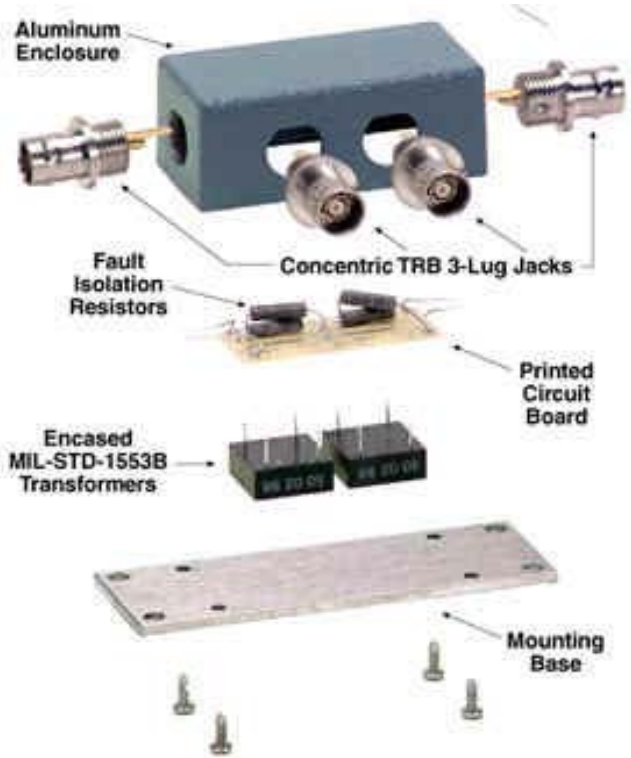
# Transmission Media & Accessories(2/3)

- **Bus Couper**
  - Transformer coupling, 1:1.41 ratio and the resistors provide a matched impedance to the bus and improve the transmitted waveform, by reducing the reflection of the signal
  - 신호 임피던스 레벨을 유지
  - 회로 합선에 대비한 버스 보호
  - 반향 감소

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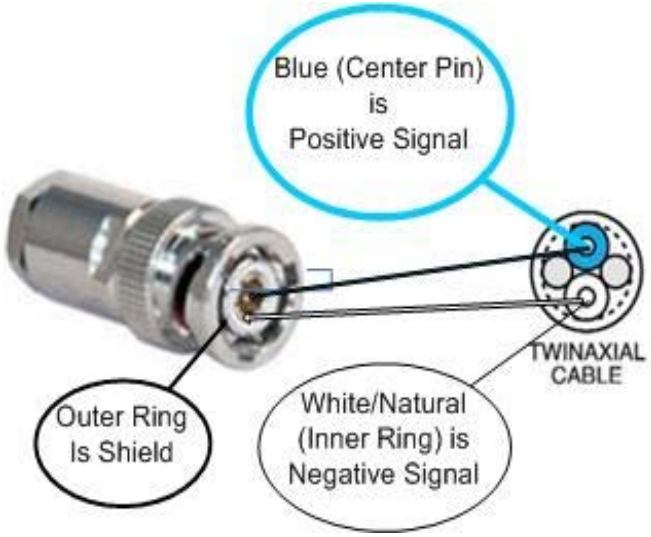
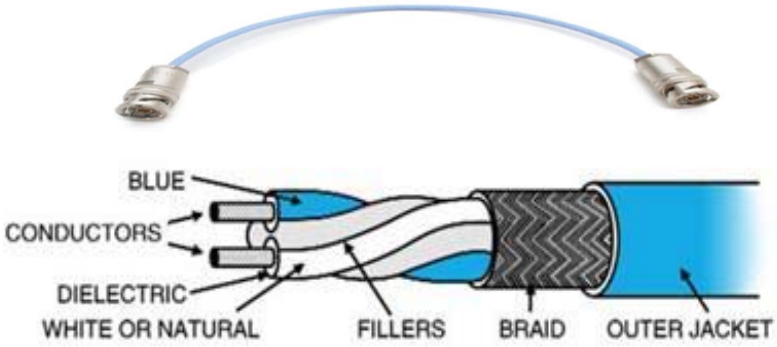
# Transmission Media & Accessories(3/3)

- **Cable**

| Property | Value |
|---|---|
| Type | Twisted-shielded pair |
| Impedance ($Z_0$) | 70 to 85 ohms at 1.0 MHz |
| Shielding Coverage | 75% minimum |
| Length of main bus | Not specified |
| Twist Four per foot | 0.33/in, minimum |

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# Bus Controller (BC)

- MIL-STD-1553 Data Bus 에서 주기능 수행:
  - 버스상의 모든 메시지 대한 명령 수행의 시발점
  - 마스터인 BC에서 RT로 보내는 command에 기초하여 메시지 전송과 수신
- Bus에 1개 이상 구성 가능 하지만 오직 1개의 BC만 운용(Active)됨
- Message 종류
  - BC to RT, RT to BC, RT to RT
  - MODE(management)

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# Remote Terminals (RT):

- BC, MT로 동작 하지 않는 모든 터미널
- 데이터 버스 및 subsystem 사이에 데이터를 전송하기 위해 필요한 전자 기기를 포함
- Subsystem

  - sensor

  - Data를 전송할 인터페이스 Device

# Bus Monitor (MT)

- BUS의 모든 메시지를 수집, 저장 후에 Off-Line 에서 상태 분석
  - Flight test recording
  - Maintenance recording
  - Mission analysis
- 모든 또는 선택적 Data 수집
  - RT, T/R, Subaddress, Word
- Data를 전송 할 수 없음

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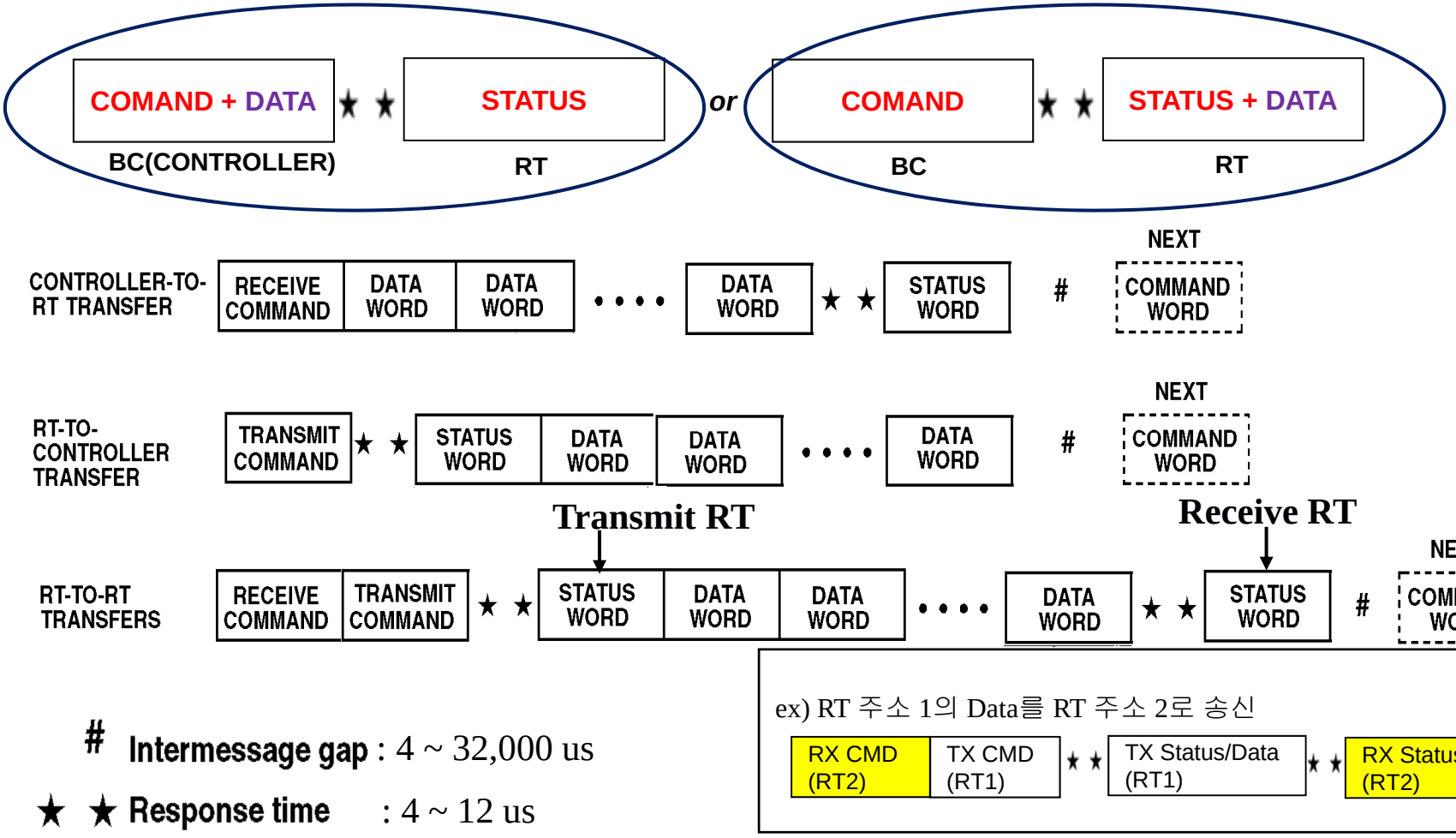
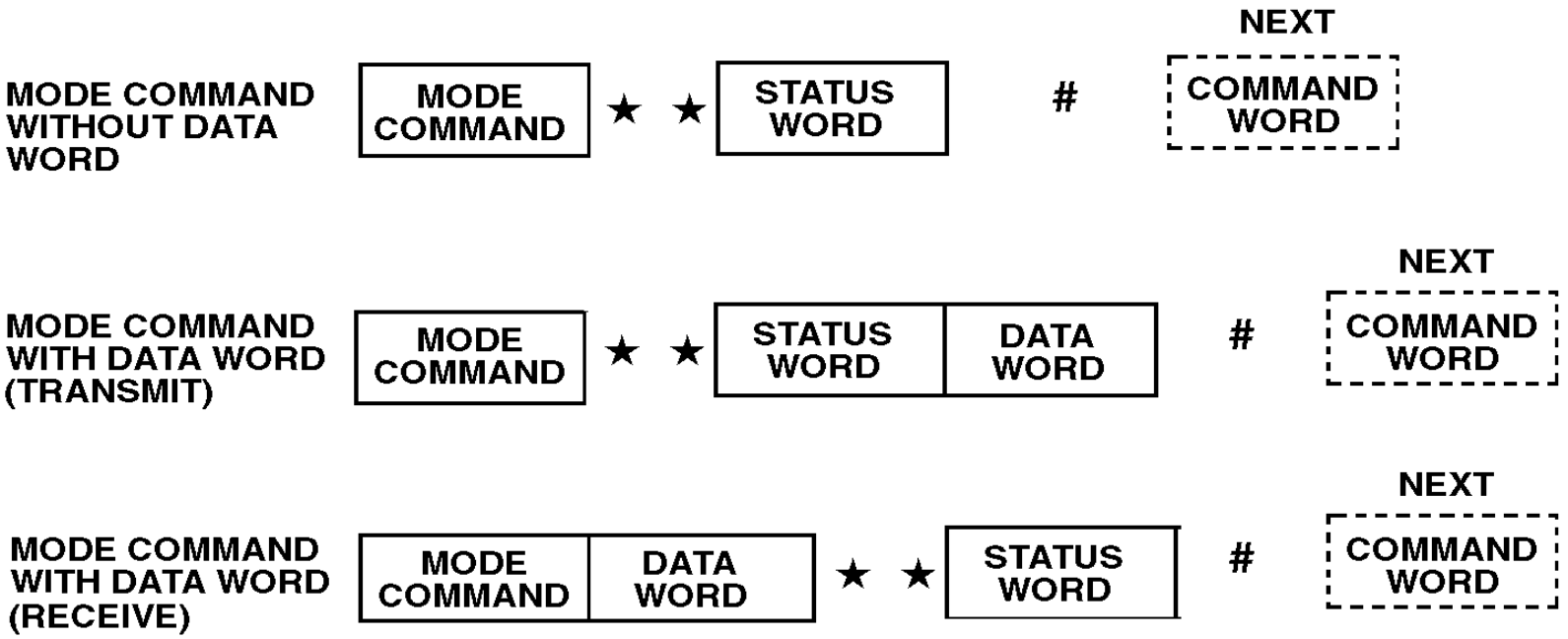
# Message Formats




# Intermessage gap : 4 ~ 32,000 us

★ ★ Response time : 4 ~ 12 us

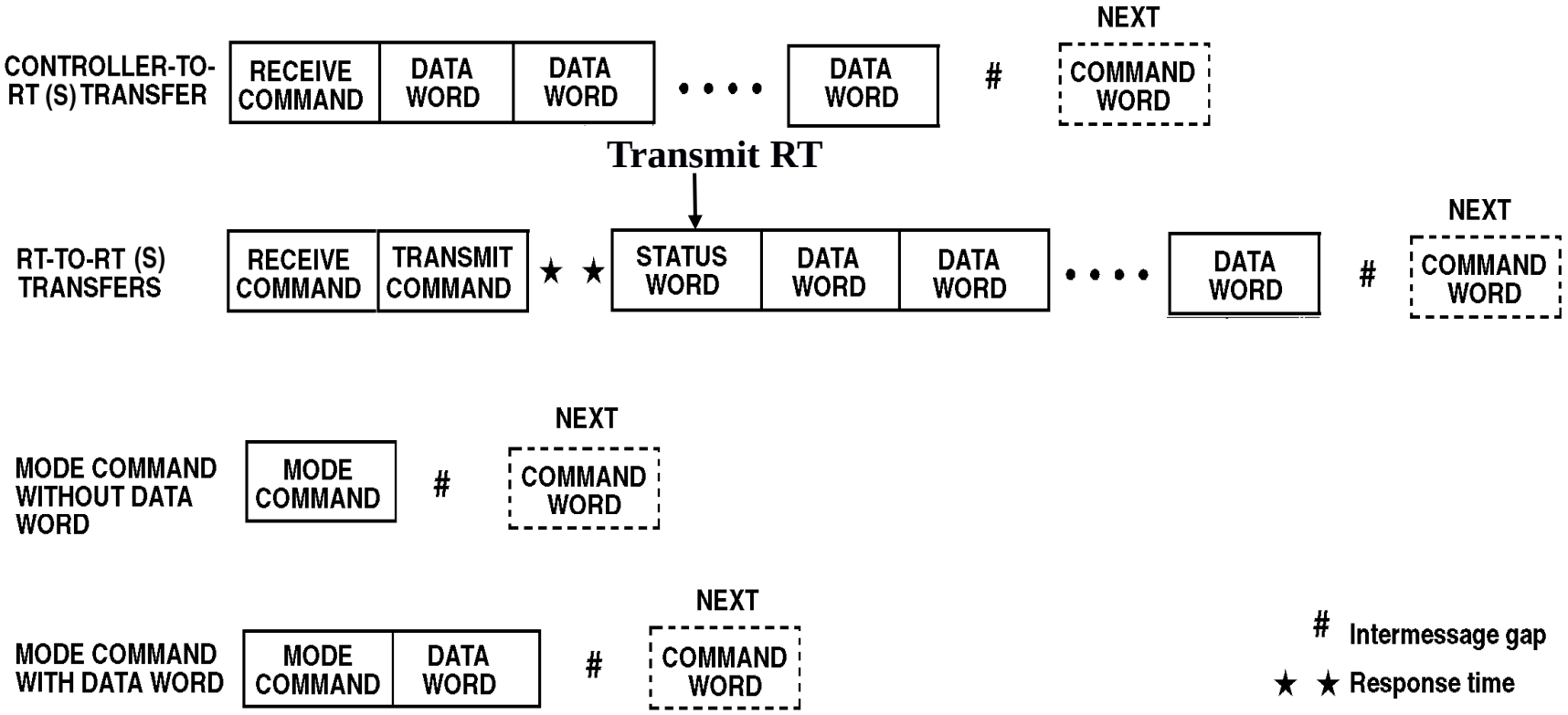
# Mode Code Message Formats




\# Intermessage gap

★ ★ Response time

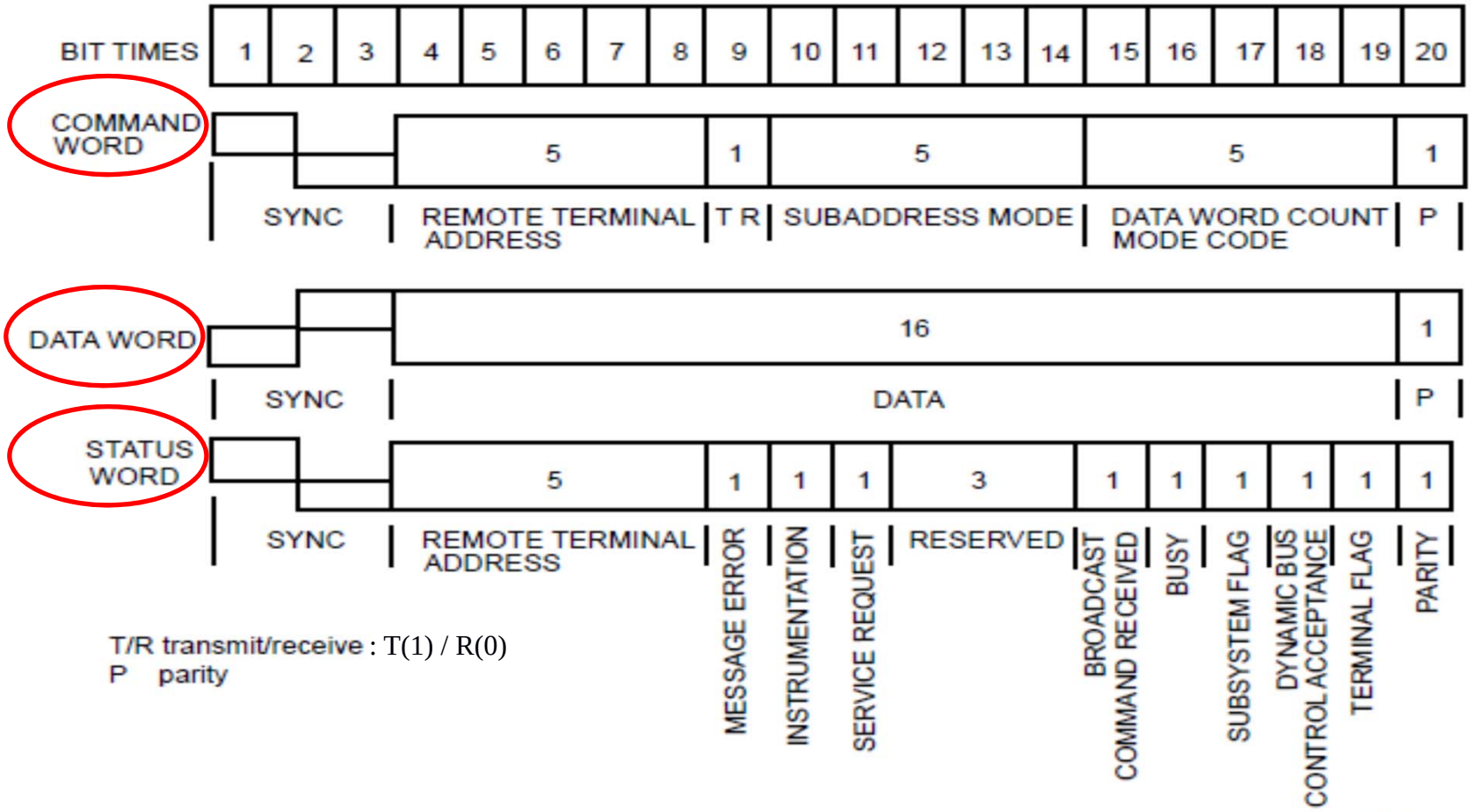
# Broadcast Message Formats




**Broadcast: RT Address = 11111**

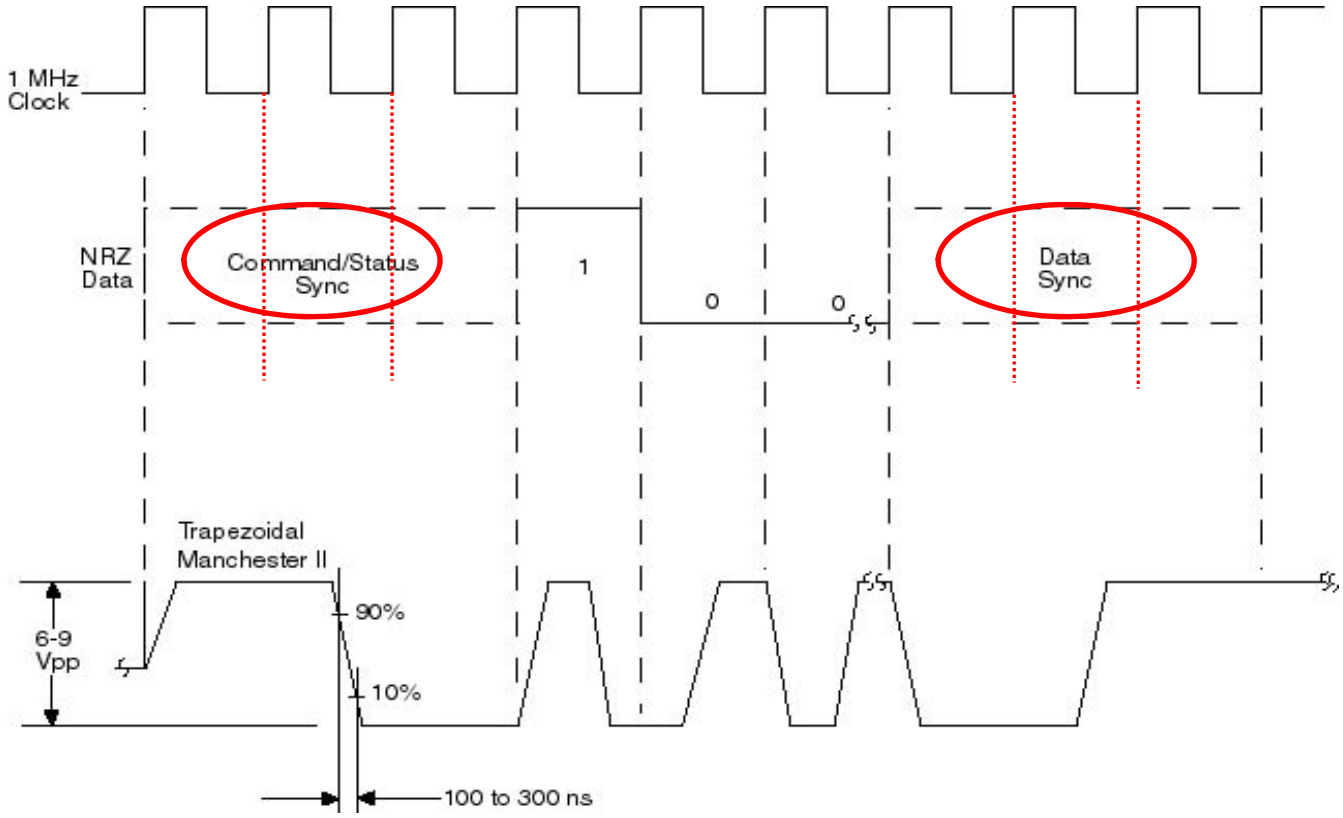
**RT는 Status Word를 BC에게 송신 하지 않는다.**

# 1553 Word Formats




T/R transmit/receive : T(1) / R(0)
P parity

# Manchester II Bi-Phase Encoding




A **logic one** & **logic zero** is transmitted as a bipolar coded signal. A transition through zero occurs at the midpoint of each bit time.

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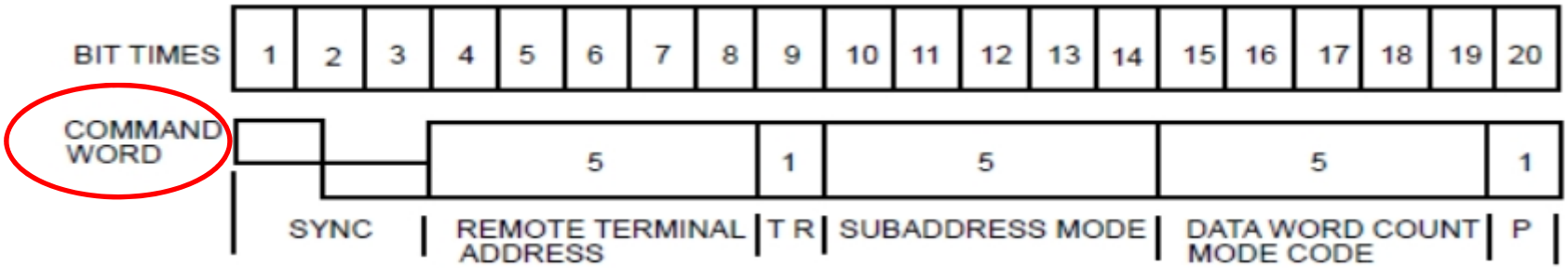
# Command Word




- **Remote Terminal Address**
  - RT Address: 0 ~ 30, 31(0x11111, Broadcast)
- **T / R**
  - Transmit( logic one, RT to BC ), Receiver( logic zero, BC to RT )
- **Sub Address / MODE**
  - Sub Address : 1~30 ( BC to RT, RT to BC, RT to RT )
  - MODE Command :31(0x11111) or 32(0x00000), MODE Code Message에만 적용
- **Data Word Count / MODE Code**
  - DATA WORD 의 Count(Length) : 1~32, 0(Wrong Count)
  - MODE Code : 0 ~ 31
- **P** : Parity
  - Odd Parity: Bit 4 ~ 20

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# Assigned 1553B Mode Codes

| T/R | MC | Function | Data Word | Broadcast |
|---|---|---|---|---|
| 1 | 00000 | Dynamic bus control | No | No |
| 1 | 00001 | Synchronize | No | Yes |
| 1 | 00010 | Transmit status word | No | No |
| 1 | 00011 | Initiate self-test | No | Yes |
| 1 | 00100 | Transmitter shutdown | No | Yes |
| 1 | 00101 | Override transmitter shutdown | No | Yes |
| 1 | 00110 | Inhibit terminal flag bit | No | Yes |
| 1 | 00111 | Override inhibit terminal flag bit | No | Yes |
| 1 | 01000 | Reset remote terminal | No | Yes |
| 1 | 01001 | Reserved | No | TBD |
| 1 | 01111 | Reserved | No | TBD |
| 1 | 10000 | Transmit vector word | Yes | No |
| 0 | 10001 | Synchronize | Yes | Yes |
| 1 | 10010 | Transmit last command | Yes | No |
| 1 | 10011 | Transmit bit word | Yes | No |
| 0 | 10100 | Selected transmitter shutdown | Yes | Yes |
| 0 | 10101 | Override selected transmitter shutdown | Yes | Yes |
| X | 10110 | Reserved | Yes | TBD |
| X | 11111 | Reserved | Yes | TBD |

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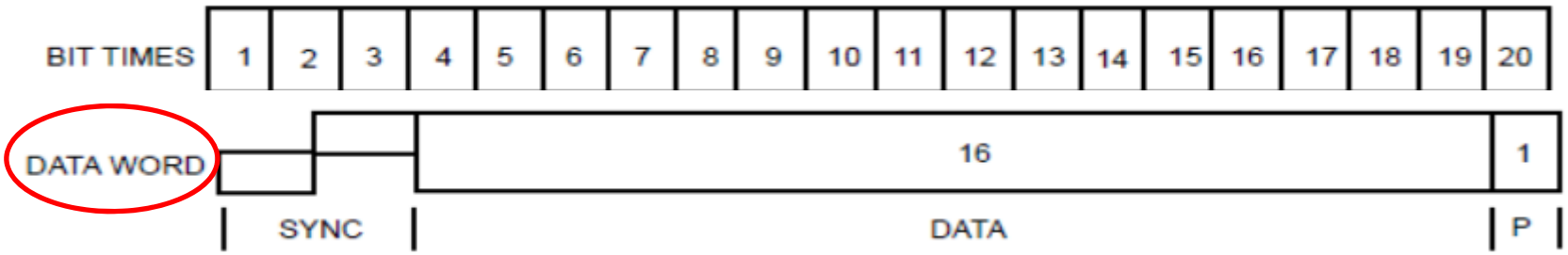
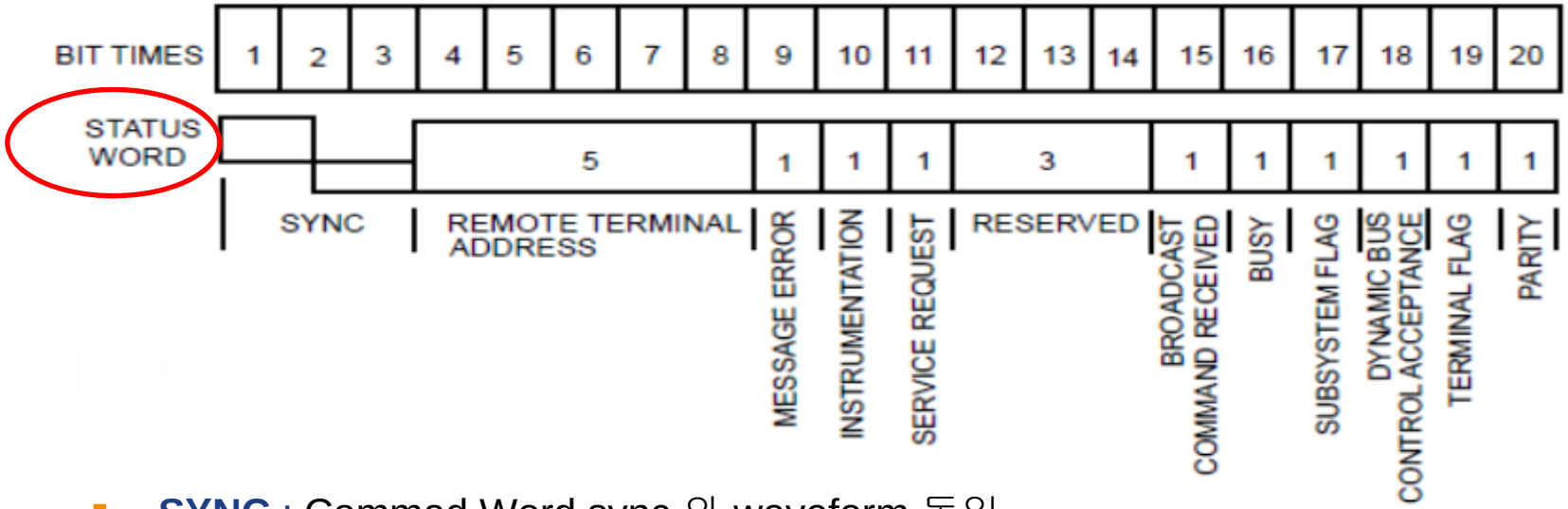
# Data Word




- **DATA**
  - 16 bit

- **P** : Parity
  - Odd Parity: Bit 4 ~ 20

# Status Word(1/3)




- **SYNC** : Commad Word sync 와 waveform 동일
- **Remote Terminal Address**
  - BC Command에 응신하는 RT 자신의 Address 0 ~ 30
    - Address 31(0x11111, Broadcast ) is Wrong
- **Message Error**
  - Normal(0), Err(1)
- **Instrumentation**
  - Option bit
  - Command Word와 Status Word 구분을 위한 비트
    - Option 으로 사용시, Command Word의 Sub Address는 0~15(0x01111)와 32(0x00000) 만 사용 가능

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# Status Word(2/3)

- **Service Request**
  - Option bit
  - Logic one
    - RT에서 BC로 Service 요청, BC에서는 Mode Command( ***Transmit Vector Word*** )를 송신하여 해당 RT에게 Service 요청
  - Logic zero(Absence)
- **RESERVED**
  - Logic zero
- **Broadcast command received**
  - Broadcast command(RT Address 31) 수신시 1로 설정 되며 BC로는 응신을 안함
  - 이 후 BC에서 Mode Command( *Transmit Status Word 또는 Transmit Last Command* ) 요청시 Status Word 송신
- **BUSY**
  - Logic one(Busy), Logic zero(Absence)
- **Subsystem Flag**
  - Logic one
    - BC에게 Subsystem의 fault 조건 존재와 Subsystem 의 데이터가 의미가 없음을 의미

# Status Word(3/3)

- **Dynamic Bus Control Acceptance**
  - 현재의 BC가 정보처리 능력이 있는 RT에게 Active BC가 되라는 제안에 대한 수락

- **Terminal Flag**
  - Option bit
  - Logic one
    - RT의 fault 상태를 BC에게 알려주는 비트로 해당 Mode Command시 사용
      - ◇ *Inhibit terminal flag(0x00110)*
      - ◇ *Override inhibit terminal flag bit(0x00111)*
      - ◇ *Transmit BIT word(0x10011)*
  - Logic zero(Absence)

- **P** : Parity
  - Odd Parity: Bit 4 ~ 20

# Summary of MIL-STD-1553

| | |
|---|---|
| Data Rate | 1 MHz |
| Word Length | 20 bits |
| Data Bits / Word | 16 bits |
| Message Length | Maximum of 32 Data Words |
| Transmission Technique | Half-duplex |
| Operation | Asynchronous |
| Encoding | Manchester II bi-phase |
| Protocol | Command / Response |
| Bus Control | Single or Multiple |
| Fault Tolerance | Dual Redundant, second bus in “Hot Standby” status |
| Messge Formats | BC to RT, RT to BC, RT to RT, Broadcast |
| Number if RT’s | Maximum of 31 |
| Terminal Types | Bus Controller / Remote Terminal / Bus Monitor |
| Transmission Media | Twisted shielded pair 70~80Ω |
| Coupling | Transformer and Direct |

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# 감사합니다.

## Contact Information

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