Antenna Interface Standards Group

Subunit Type Standard AISG-ST-TMA

vTMA3.0.6.2

June 27th, 2024

Tower Mounted Amplifier
AISG-ST-TMA
vTMA3.0.6.2

Revision History

DATE	ISSUE	NOTES
June 27th, 2024	vTMA3.0.6.2	Sixth public release
June 29th, 2023	vTMA3.0.5.2	Fifth public release
January 31st, 2022	vTMA3.0.4.1	Fourth public release
June 8th, 2019	vTMA3.0.2.0	Third public release
February 6th, 2019	vTMA3.0.1.0	Second public release
November 5th, 2018	vTMA3.0.0.6	First public release

Antenna Interface Standards Group
Subunit Type Standard AISG-ST-TMA
vTMA3.0.6.2

June 27th, 2024

1. FOREWORD

This standard has been produced by the Antenna Interface Standards Group (AISG) to introduce and define new features and enhancement of the management system for antenna line devices (ALDs) with remote control and monitoring facilities. AISG v3.0 base document describes the common behaviour of antenna line devices with AISG interfaces and type-specific functionality is defined in subunit type standards. This subunit type standard covers tower mounted amplifiers (sometimes referred to as masthead or ground mounted amplifiers).

This standard is independent of previous 3GPP standards.

2. SCOPE

AISG v3.0 specifies the standard data interface between a primary, typically a base station, and antenna line devices (ALDs) which are manageable units, usually associated with base station antennas.

The standard is divided into the base document and several subunit type standards. This subunit type standard document describes the specific behaviour of the tower mounted amplifier (TMA) subunit type.

This standard defines the functional behaviour of the TMA subunits.

2.1. Interpretation (Normative)

The text of the standard defines explicitly what is required or permitted. Anything that is not explicitly allowed is not permitted.

All statements in the current document are normative, unless indicated as informative or example.

For purposes of compliance and AISG interoperability, users should note that the implementation of this subunit type standard is optional. However, once it is selected for inclusion in a product, the entire standard becomes mandatory.

3. REFERENCES

This AISG Standard incorporates provisions from other publications. These are cited in the text and the referenced publications are listed below. Where references are listed with a specific version or release, subsequent amendments or revisions of these publications apply only when specifically incorporated by amendment or revision of this AISG standard. For references listed without a version or release, the latest edition of the publication referred to applies.

1 AISG v3.0: “Base Standard AISG v3.0”

2 AISG v3.0 STCM: “Subunit Type Compliance Matrix”

4. VERSION COMPLIANCE (Informative)

The compliance of this standard with different version of AISG v3 baseline standard is defined in [2].

5. ABBREVIATIONS (Informative)

Where abbreviations or acronyms are used in this document they have the following meanings:

ALD	Antenna Line Device
DC	Direct Current
LNA	Low Noise Amplifier
MALD	Multi-primary ALD
RF	Radio Frequency
SALD	Single-primary ALD
TCC	Time-Consuming Command
TMA	Tower Mounted Amplifier
3GPP	3rd Generation Partnership Project

6. TERMINOLOGY

Where the following terms are used in this document, they have the following meanings:

Estimated gain	An estimation of the TMA gain in the current circumstances supplied by the TMA subunit. It may take into account, if available, information from LNA and bypass diagnostics, and possible LNA or bypass circuitry failure(s).
Gain	A factor by which signal power is increased in an amplifier, usually expressed in dB.
LNA path	A path including LNA and possible bypass switches.
Low noise amplifier	An amplifier that amplifies a very low power signal without significantly degrading its signal-to-noise ratio.
TMA bypass	An RF path around an LNA to provide alternative route.
TMA bypass path	An RF path around an LNA including bypass switches.
TMA bypass switch	A functionality that switches between normal and bypass mode.
TMA gain	Uplink insertion gain between two interconnected RF ports, where referred TMA subunit has relationship with both ports.
Tower mounted amplifier	A unit typically providing uplink and downlink path and containing an LNA and associated filters.

7. DEFINITIONS

GainTable shall be initialised on reset to contain the possible gain settings of the TMA.

```
uint8_t NrOfGainRanges

GainRange_t GainTable[NrOfGainRanges]
```

TMAMode_t is used to identify the normal or bypass mode of TMA.

```
Enumeration TMAMode_t: uint8_t {
      BypassMode ← 0
      NormalMode ← 1
}

PERSISTENT TMAMode_t TMAMode

Enumeration TMAAlarmCode_t : uint16_t {
      TMAAlarmLNAFailed          ← 0x0200
      TMAAlarmBypassFailed       ← 0x0201
      TMAAlarmNoRXConnection     ← 0x0202
}

Enumeration ActivePath_t : uint8_t {
      LNAPath          ← 0
      BypassPath       ← 1
      None             ← 2
}

ActivePath_t             TMAActivePath

PERSISTENT ddB_t TMAGain

CONST uint16_t NrOfSubunitAlarms ← 3      // Number of subunit alarm types for
                                          // this subunit type
```

8. GENERAL ASPECTS

8.1. Subunit association

A TMA subunit may be associated with two or more RF ports with interconnections between some or all of these ports.

8.2. State models

8.2.1. TMA state model for layer 7

TMA state model has 11 states, which are listed with ID numbers in Annex A. The inputs for the state model are shown in figure 8.2.1-1 “Input to TMAState state model”, which shows the relationship between different states of the TMA path, Bypass path and TMA mode. Transitions to certain states may require diagnostic capabilities.

In LNAPathOKState the LNA path is fully operational and amplifies the signal.

In LNAPathImpairedState the LNA path is operational but with reduced amplification performance.

In LNAPathBrokenState the LNA path is unable to amplify the signal and may be heavily attenuated.

In BypassPathOKState the bypass path is fully operational and transfers the signal.

In BypassPathBrokenState the bypass path may be heavily attenuated.

```
Enumeration LNAPathState_t : uint8_t {
     LNAPathOKState             ← 0
     LNAPathBrokenState         ← 1
     LNAPathImpairedState       ← 2
}

LNAPathState_t       LNAPathState
Enumeration BypassPathState_t : uint8_t {
     BypassPathOKState          ← 0
     BypassPathBrokenState      ← 1
}

BypassPathState_t    BypassPathState
```

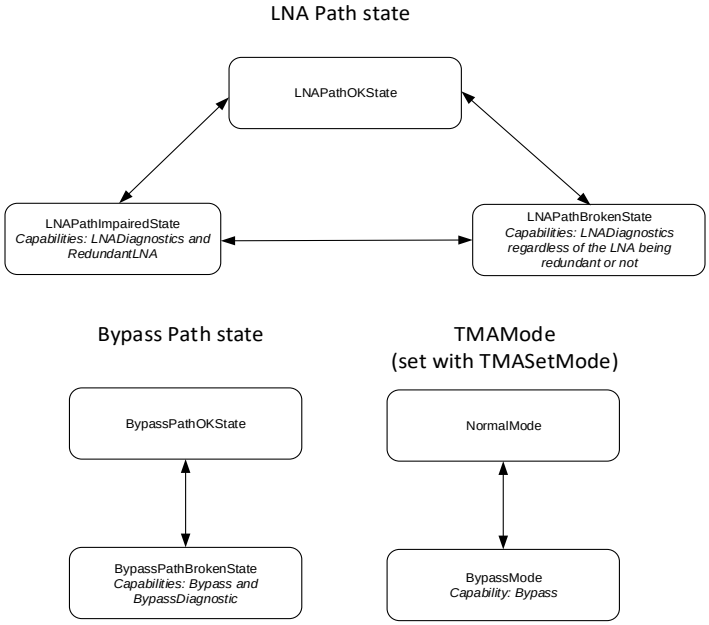

Figure 8.2.1-1 Input to TMAState state model

8.3. TMA capabilities

TMA capabilities are defined by the vendor and fixed at the factory. The TMACapabilities bitfield of all subunits shall be initialised during reset.

```
Bitfield TMACapabilities_t : uint8_t {
     LNADiagnostics       : Bit 0              // Able to diagnose LNA failure
     Bypass               : Bit 1
     RedundantLNA         : Bit 2              // Multiple redundant amplifiers
     BypassDiagnostics    : Bit 3              // Able to diagnose bypass
                                               // switch failure
     AdjustableGain       : Bit 4              // Has several gain settings,
                                               // that is, it is not fixed gain
     GainEstimation       : Bit 5              // Able to estimate the TMA gain
}
TMACapabilities_t TMACapabilities
```

8.4. TMA gain ranges

The primary can query the gain ranges supported by the TMA subunit using the TMAGetCapabilities command.

If the TMA subunit has fixed gain, it shall respond to the TMAGetCapabilities command with one gain range having gain step size 0, and both the minimum gain and maximum gain values set to the fixed nominal gain value supported by the TMA.

If the TMA subunit has adjustable gain range(s), it shall respond to the TMAGetCapabilities command with one or more gain ranges according to the gain range(s) that the TMA supports.

See [1] for details and examples of encoding gain ranges.

8.5. Return codes

This subunit type standard contains the following subunit type specific return codes.

```
Enumeration ReturnCode_t : uint16_t {
      TMAUnsupportedGainValue    ← 0x0200
      TMAMajorFault              ← 0x0201
      TMAMinorFault              ← 0x0202
}
```

8.6. Default values when shipped from the factory

The default values of TMARequestedMode and TMARequestedGain are vendor specific. The vendor shall indicate in the product documentation with which default values the TMA is shipped.

8.7. Resumption of operation

The following data are initially set at the factory, and shall be retained after reset:

- TMAMode
- TMAGain

After reset, TMA shall perform EvaluateTMAState function.

9. LAYER 1

All definitions and standards for ALDs in [1] regarding layer 1 shall be valid for ALDs which contain TMA subunits.

9.1. DC power consumption

This subunit type standard does not define the power consumption of a TMA. See [1] for details on how power consumption is reported to the primary.

This subunit type standard does not contain any commands that switch the ALD from SteadyStatePowerMode to HighPowerMode or to SleepPowerMode.

10. LAYER 2

All definitions and standards for ALDs in [1] regarding layer 2 shall be valid for ALDs which contain TMA subunits.

11. LAYER 7

An ALD which contains TMA subunit(s) shall support the command set which is defined in [1] in addition to those commands specified in this standard.

11.1. Subunit type

Subunit type	1-octet unsigned integer code
TMA	0x02

Table 11.1-1: Subunit type code

11.2. Overview of commands for TMA subunits

The table below shows an overview of all commands used in this TMA subunit type standard.

The following abbreviations are used in the Table 11.2-1 ”Commands for TMA subunits”:

M Mandatory

O Optional

- Not applicable

TMA Command	Code	Initiator	Subunit	Timeout	TCC	Mandatory for:			Changes the ConnectionState	Changes the PowerMode	Minimum required authority
						Primary	SALD	MALD			
TMA Get Capabilities	0x0200	Primary	>0	1 s	no	M	M	M	no	no	RO
TMA Set Mode	0x0201	Primary	>0	1 s	no	M	O	O	no	no	RW
TMA Get Mode	0x0202	Primary	>0	1 s	no	M	M	M	no	no	RO
TMA Set Gain	0x0203	Primary	>0	1 s	no	M	O	O	no	no	RW
TMA Get Gain	0x0204	Primary	>0	1 s	no	M	M	M	no	no	RO

Table 11.2-1: Commands for TMA subunits

11.3. Updating of TMA state

Function EvaluateTMAState() is called:

- on reset – to determine initial state of TMA
- when user requests a change of TMA mode
- when a state of LNA or bypass path changes

The function is executed in the context of a TMA subunit. Re-raising an alarm with same severity shall result only in updating the diagnostic string associated with the alarm. TMA state IDs are described in Annex A.

```
struct AlarmDetails_t {
        Severity_t   Severity
        UTF8String_t       DiagnosticString
}

FUNCTION EvaluateTMAState(uint16_t Subunit) IS

//Outputs of the evaluation
AlarmDetails_t LNAAlarm
AlarmDetails_t BypassAlarm
AlarmDetails_t RxConnectionAlarm

LNAAlarm.Severity ← Cleared
LNAAlarm.DiagnosticString ← “”
BypassAlarm.Severity ← Cleared
BypassAlarm.DiagnosticString ← “”
RxConnectionAlarm.Severity ← Cleared
RxConnectionAlarm.DiagnosticString ← “”

CASE LNAPathStatus IS

        WHEN LNAPathOK:
                IF TMAMode = BypassMode THEN
                        IF BypassPathState = BypassPathBrokenState THEN // TMA state ID 4
                                TMAActivePath ← LNAPath
                                BypassAlarm.Severity ← Minor
                                BypassAlarm.DiagnosticString ← “Bypass path failed”
                        ELSEIF // TMA state ID 3
                                TMAActivePath ← BypassPath
                        ENDIF
                ELSE // TMA state ID 1,2
                        TMAActivePath ← LNAPath
                ENDIF
```

```
        WHEN LNAPathImpaired:
            LNAAlarm.Severity ← Minor
            LNAAlarm.DiagnosticString ← “LNA path impaired”
            IF TMAMode = BypassMode THEN
                IF BypassPathState = BypassPathBrokenState THEN // TMA state ID 8
                    TMAActivePath ← LNAPath
                    BypassAlarm.Severity ← Minor
                    BypassAlarm.DiagnosticString ← “Bypass path failed”
                ELSE
                    TMAActivePath ← BypassPath // TMA state ID 7
                ENDIF
            ELSE
                TMAActivePath = LNAPath // TMA state ID 5,6
            ENDIF
        OTHERWISE           //i.e. LNAPathStatus = LNAPathBroken
            IF NOT TMACapabilities.Bypass THEN // TMA state ID 9
                TMAActivePath ← None
                RxConnectionAlarm.Severity ← Major
                RxConnectionAlarm.DiagnosticString ← “LNA path broken”
            ELSEIF BypassPathState = BypassPathOKState // TMA state ID 10
                TMAActivePath ← BypassPath
                LNAAlarm.Severity ← Major
                LNAAlarm.DiagnosticString ← “LNA path broken”
            ELSE // BypassPathState = BypassPathBrokenState, TMA state ID 11
                TMAActivePath ← None
                RxConnectionAlarm.Severity ← Major
                RxConnectionAlarm.DiagnosticString ← “LNA and bypass paths broken”
            ENDIF
ENDCASE

IF TMAActivePath = LNAPath
    «Switch signal path to LNA path»
ELSEIF TMAActivePath = BypassPath
    «Switch signal path to TMA bypass path»
ENDIF

CASE LNAAlarm.Severity IS
    WHEN Major:
        RAISE TMAAlarmLNAFailed SEVERITY Major ON Cmd.Subunit,
        LNAAlarm.DiagnosticString
    WHEN Minor:
        RAISE TMAAlarmLNAFailed SEVERITY Minor ON Cmd.Subunit,
        LNAAlarm.DiagnosticString
    OTHERWISE:
        CLEAR TMAAlarmLNAFailed ON Cmd.Subunit
ENDCASE
```

```
IF RxConnectionAlarm.Severity = Cleared THEN
        CLEAR TMAAlarmNoRXConnection ON Cmd.Subunit
ELSE
        RAISE TMAAlarmNoRXConnection SEVERITY Major
        ON Cmd.Subunit, LNAAlarm.DiagnosticString
ENDIF

IF BypassAlarm.Severity = Cleared THEN
        CLEAR TMAAlarmBypassFailed ON Cmd.Subunit
ELSE
        RAISE TMAAlarmBypassFailed SEVERITY Minor
        ON Cmd.Subunit, LNAAlarm.DiagnosticString
ENDIF
END
```

11.3.1. Events

```
ON «TMA bypass path's condition change» DO
        IF «bypass path is broken» THEN
                SWITCH BypassPathState TO BypassPathBrokenState
        ELSE
                SWITCH BypassPathState TO BypassPathOKState
        ENDIF
        EvaluateTMAState(Cmd.Subunit)
DONE

ON «LNA path's condition change» DO
        IF «LNA path is broken» THEN
                SWITCH LNAPathState TO LNAPathBrokenState
        ELSE IF «at least one, but not all, redundant amplifiers have failed» THEN
                SWITCH LNAPathState TO LNAPathImpairedState
        ELSE
                SWITCH LNAPathState TO LNAPathOKState
        ENDIF
        EvaluateTMAState(Cmd.Subunit)
DONE
```

11.4. Reset

```
ON Reset DO
        EvaluateTMAState()
DONE
```

11.5. TMA commands

11.5.1. TMA Get Capabilities

Description (Informative):

On receipt of the command, the ALD shall respond with the capabilities and parameters indicating the functionalities of the addressed TMA subunit.

The supported gain ranges shall follow the definitions in [1]. Gain value in bypass state shall not be reported as part of the gain ranges.

The frequency ranges in the response reflect the capabilities of the TMA; not the current usage by the primary.

Bit value 0 represents function is not supported. Bit value 1 represents function is supported.

Message format:

```
PrimaryCommand TMAGetCapabilitiesCommand {
      CommandCode_t         Command ← 0x0200
      CommandSequence_t     PrimaryCommandSequence
      Subunit_t             Subunit
      DataLength_t          DataLength ← 0
}

ALDResponse TMAGetCapabilitiesResponse {
      CommandCode_t         Command ← 0x0200
      CommandSequence_t     PrimaryCommandSequence
      ReturnCode_t          ReturnCode
      DataLength_t          DataLength
      if (ReturnCode == OK) {
            TMACapabilities_t     TMACapabilities
            uint8_t               NrOfGainRanges
            GainRange_t           Ranges[1..NrOfGainRanges]
            uint8_t               NrOfFrequencyRanges
            FrequencyRange_t      Ranges[1..NrOfFrequencyRanges]
      }
      else {
            ALDState_t            ALDState
            ConnectionState_t     ConnectionState
      }
}

Enumeration ReturnCode_t {
      // The following are return codes from command message validation (see section
      // 12.6.2 in [1])
      FormatError
      UnknownCommand
      InvalidSubunitNumber
      ProtocolVersionNotNegotiated
      InvalidSubunitType
      // The following are return codes from command pseudocode below
      NotAuthorised
      NotAControlPort
      IncorrectState
      Busy
      InUseByAnotherPrimary
      OK
}
```

Primary pseudocode:

(This section is intentionally left blank)

ALD pseudocode:

```
uint16_t CurrentPortIndex

CurrentPortIndex ← INDEX OF CurrentPort IN AISGPorts

IF ALDType = MALD
      AND ActiveAuth[CurrentPortIndex].Authority[Cmd.Subunit] = NoAccess THEN
      RETURN NotAuthorised
      EXIT
ENDIF

result ← IsCommandAllowed( LIST{     OperatingConnectionState,
                                     RestrictedConnectionState},
                                     Cmd.Command, CurrentPort)

UNLESS result.allowed THEN
      RETURN result.code
      EXIT
ENDIF

RETURN OK, TMACapabilities, NrOfGainRanges, LIST for every gain range {Min, Max,
StepSize}, NrOfFrequencyRanges, LIST for every frequency range {LinkDescriptor, Min,
Max}
CommandExit(Cmd.Command, CurrentPort)
EXIT
```

11.5.2. TMA Set Mode

Description (Informative):

The TMA Set Mode procedure shall only be supported if the TMA subunit can be set in bypass mode. On receipt of the command, the ALD shall first initialise the TMA subunit in the requested mode, and then return a response message. If a TMA subunit in bypass mode receives the command TMASetMode to BypassMode, the command shall not be performed but the response OK shall be returned. Similarly, if a TMA subunit in normal mode receives the command TMASetMode to NormalMode, the command shall not be performed but the response OK shall be returned.

Message format:

```
PrimaryCommand TMASetModeCommand {
      CommandCode_t         Command ← 0x0201
      CommandSequence_t     PrimaryCommandSequence
      Subunit_t             Subunit
      DataLength_t          DataLength ← 1
      TMAMode_t             Mode
}
```

```
ALDResponse TMASetModeResponse {
      CommandCode_t         Command ← 0x0201
      CommandSequence_t     PrimaryCommandSequence
      ReturnCode_t          ReturnCode
      DataLength_t          DataLength
      if (ReturnCode == OK) {
      }
      else {
            ALDState_t            ALDState
            ConnectionState_t     ConnectionState
      }
}

Enumeration ReturnCode_t {
      // The following are return codes from command message validation (see section
      // 12.6.2 in [1])
      FormatError
      UnknownCommand
      InvalidSubunitNumber
      ProtocolVersionNotNegotiated
      InvalidSubunitType
      // The following are return codes from command pseudocode below
      NotAuthorised
      UnsupportedCapability
      UnsupportedValue
      NotAControlPort
      IncorrectState
      Busy
      InUseByAnotherPrimary
      OK
}
```

Primary pseudocode:

(This section is intentionally left blank)

ALD pseudocode:

```
uint16_t CurrentPortIndex

CurrentPortIndex ← INDEX OF CurrentPort IN AISGPorts

IF ALDType = MALD THEN
      UNLESS ActiveAuth[CurrentPortIndex].Authority[Cmd.Subunit] = ReadWrite THEN
            RETURN NotAuthorised
            EXIT
      ENDIF
ENDIF

UNLESS TMACapabilities.Bypass THEN
      RETURN UnsupportedCapability
      EXIT
ELSEIF Cmd.Mode ≠ NormalMode AND Cmd.Mode ≠ BypassMode THEN
      RETURN UnsupportedValue
      EXIT
ENDIF
```

```
result ← IsCommandAllowed( LIST{      OperatingConnectionState,
                                      RestrictedConnectionState},
                                      Cmd.Command, CurrentPort)

UNLESS result.allowed THEN
      RETURN result.code
      EXIT
ENDIF

IF Cmd. Mode ≠ TMAMode THEN           // If Primary is requesting
      TMAMode ← Cmd.Mode              // different TMA mode than the
      EvaluateTMAState(Cmd.Subunit)   // current, update current mode
ENDIF                                 // and re-evaluate TMA states

RETURN OK
CommandExit(Cmd.Command, CurrentPort)
EXIT
```

11.5.3. TMA Get Mode

Description (Informative):

On receipt of the command, the ALD shall respond with the mode flag indicating whether the TMA subunit is set in NormalMode or in BypassMode. TMA subunits which do not support BypassMode shall return NormalMode.

For the default mode of the TMA see section 8.5 "Resumption of operation".

Message format:

```
PrimaryCommand TMAGetModeCommand {
      CommandCode_t         Command ← 0x0202
      CommandSequence_t     PrimaryCommandSequence
      Subunit_t             Subunit
      DataLength_t          DataLength ← 0
}

ALDResponse TMAGetModeResponse {
      CommandCode_t         Command ← 0x0202
      CommandSequence_t     PrimaryCommandSequence
      ReturnCode_t          ReturnCode
      DataLength_t          DataLength
      if (ReturnCode == OK) {
            TMAMode_t       TMAMode
            ActivePath_t    ActivePath
      }
      else {
            ALDState_t            ALDState
            ConnectionState_t     ConnectionState
      }
}
```

```
Enumeration ReturnCode_t {
      // The following are return codes from command message validation (see section
      // 12.6.2 in [1])
      FormatError
      UnknownCommand
      InvalidSubunitNumber
      ProtocolVersionNotNegotiated
      InvalidSubunitType
      // The following are return codes from command pseudocode below
      NotAuthorised
      NotAControlPort
      IncorrectState
      Busy
      InUseByAnotherPrimary
      OK
}
```

Primary pseudocode:

(This section is intentionally left blank)

ALD pseudocode:

```
uint16_t CurrentPortIndex

CurrentPortIndex ← INDEX OF CurrentPort IN AISGPorts

IF ALDType = MALD
      AND ActiveAuth[CurrentPortIndex].Authority[Cmd.Subunit] = NoAccess THEN
      RETURN NotAuthorised
      EXIT
ENDIF

result ← IsCommandAllowed( LIST{      OperatingConnectionState,
                                      RestrictedConnectionState},
                                      Cmd.Command, CurrentPort)

UNLESS result.allowed THEN
      RETURN result.code
      EXIT
ENDIF

RETURN OK, TMAMode, TMAActivePath
CommandExit(Cmd.Command, CurrentPort)
EXIT
```

11.5.4. TMA Set Gain

Description (Informative):

On receipt of the command, the ALD shall set the addressed TMA subunit to the gain value sent by the primary. The parameter Gain is defined as dB_t. See base standard for the definition of this type.

TMA Set Gain command does not change the TMA mode. In particular, if the TMA subunit is in bypass mode, and TMASetGain is received, then the gain setting shall be changed and the bypass mode shall be retained.

Gain shall be accepted if the requested gain value is supported.

For unsupported values the TMA subunit shall respond TMAUnsupportedGainValue.

Message format:

```
PrimaryCommand TMASetGainCommand {
      CommandCode_t         Command ← 0x0203
      CommandSequence_t     PrimaryCommandSequence
      Subunit_t             Subunit
      DataLength_t          DataLength ← 2
      ddB_t                 Gain
}

ALDResponse TMASetGainResponse {
      CommandCode_t         Command ← 0x0203
      CommandSequence_t     PrimaryCommandSequence
      ReturnCode_t          ReturnCode
      DataLength_t          DataLength
      if (ReturnCode == OK) {
      }
      else {
            ALDState_t            ALDState
            ConnectionState_t     ConnectionState
      }
}

Enumeration ReturnCode_t {
      // The following are return codes from command message validation (see section
      // 12.6.2 in [1])
      FormatError
      UnknownCommand
      InvalidSubunitNumber
      ProtocolVersionNotNegotiated
      InvalidSubunitType
      // The following are return codes from command pseudocode below
      NotAuthorised
      NotAControlPort
      IncorrectState
      Busy
      InUseByAnotherPrimary
      TMAMajorFault
      TMAMinorFault
      TMAUnsupportedGainValue
      OK
}
```

Primary pseudocode:

(This section is intentionally left blank)

ALD pseudocode:

```
uint16_t CurrentPortIndex

CurrentPortIndex ← INDEX OF CurrentPort IN AISGPorts

IF ALDType = MALD THEN
    UNLESS ActiveAuth[CurrentPortIndex].Authority[Cmd.Subunit] = ReadWrite THEN
        RETURN NotAuthorised
        EXIT
    ENDIF
ENDIF

result ← IsCommandAllowed( LIST{    OperatingConnectionState,
                                    RestrictedConnectionState},
                                    Cmd.Command, CurrentPort)

UNLESS result.allowed THEN
    RETURN result.code
    EXIT
ENDIF

IF «TMA is in Bypass mode due to major TMA fault» THEN
    RETURN TMAMajorFault
    CommandExit(Cmd.Command, CurrentPort)
    EXIT
ENDIF

IF «TMA is in NormalMode AND gain setting cannot be achieved» THEN
    // The possible gain settings are defined by the vendor
    RETURN TMAMinorFault
    CommandExit(Cmd.Command, CurrentPort)
    EXIT
ENDIF

FOREACH I FROM 1 TO NrOfGainRanges DO
    NEXT IF Cmd.Gain > GainTable[I].Max

    IF Cmd.Gain < GainTable[I].Min THEN
        RETURN TMAUnsupportedGainValue
    ELSEIF Cmd.Gain = GainTable[I].Min          // Special case covering
                                                // GainTable[I].StepSize = 0
        OR (Cmd.Gain − GainTable[I].Min) MOD GainTable[I].StepSize = 0 THEN
        TMAGain ← Cmd.Gain
        RETURN OK
    ELSE
        RETURN TMAUnsupportedGainValue
    ENDIF

    CommandExit(Cmd.Command, CurrentPort)
    EXIT
DONE
```

RETURN TMAUnsupportedGainValue
CommandExit(Cmd.Command, CurrentPort)
EXIT

11.5.5. TMA Get Gain

Description (Informative):

On receipt of the command, the ALD shall return the TMAGain, TMAEstimatedGain and the TMAMode of the TMA subunit.

Support for estimated gain is optional and is indicated by the TMA capability GainEstimation. The algorithm to provide the value for the TMAEstimatedGain is vendor specific. Estimated gain value, shall represent the current best estimate of the TMA gain.

If the gain estimation capability is not supported, the ALD shall return the TMAGain as the TMAEstimatedGain.

A TMA with fixed gain shall return the fixed gain value as the TMAGain. A TMA with adjustable gain shall return the current TMAGain. These behaviours apply to both normal and bypass modes.

For default gain of the TMA see section 8.5 "Resumption of operation".

Message format:

```
PrimaryCommand TMAGetGainCommand {
      CommandCode_t         Command ← 0x0204
      CommandSequence_t     PrimaryCommandSequence
      Subunit_t             Subunit
      DataLength_t          DataLength ← 0
}

ALDResponse TMAGetGainResponse {
      CommandCode_t         Command ← 0x0204
      CommandSequence_t     PrimaryCommandSequence
      ReturnCode_t          ReturnCode
      DataLength_t          DataLength
      if (ReturnCode == OK) {
            ddB_t           TMAGain
            ddB_t           TMAEstimatedGain
            TMAMode_t       TMAMode
      }
      else {
            ALDState_t            ALDState
            ConnectionState_t     ConnectionState
      }
}
```

```
Enumeration ReturnCode_t {
      // The following are return codes from command message validation (see section
      // 12.6.2 in [1])
      FormatError
      UnknownCommand
      InvalidSubunitNumber
      ProtocolVersionNotNegotiated
      InvalidSubunitType
      // The following are return codes from command pseudocode below
      NotAuthorised
      NotAControlPort
      IncorrectState
      Busy
      InUseByAnotherPrimary
      OK
}
```

Primary pseudocode:

(This section is intentionally left blank)

ALD pseudocode:

```
uint16_t CurrentPortIndex

CurrentPortIndex ← INDEX OF CurrentPort IN AISGPorts

IF ALDType = MALD
      AND ActiveAuth[CurrentPortIndex].Authority[Cmd.Subunit] = NoAccess THEN
      RETURN NotAuthorised
      EXIT
ENDIF

result ← IsCommandAllowed( LIST{      OperatingConnectionState,
                                      RestrictedConnectionState},
                                      Cmd.Command, CurrentPort)

UNLESS result.allowed THEN
      RETURN result.code
      EXIT
ENDIF

IF GainEstimation THEN                          // If the TMA has GainEstimation capability
      TMAEstimatedGain ← «gain estimation by TMA»     // Return gain estimation
ELSE                                            // if GainEstimation capability is not supported
      TMAEstimatedGain ← TMAGain                // Return TMAGain as the TMAEstimatedGain
ENDIF

RETURN OK, TMAGain, TMAEstimatedGain, TMAMode

CommandExit(Cmd.Command, CurrentPort)
EXIT
```

Annex A: TMA State ID (Informative):

TMA state IDs shown in the pseudocode are listed in Table A-1.

TMA State ID	Inputs			Outputs		Expected TMA gain
	LNA path status	Mode	Bypass path status	Selected path	Alarms	
1	OK	Normal	OK	LNApath	None	SetGain
2	OK	Normal	Broken	LNApath	None	SetGain
3	OK	Bypass	OK	BypassPath	None	< 0 dB
4	OK	Bypass	Broken	LNApath	BypassFailed Minor "Bypass path failed"	SetGain
5	Impaired	Normal	OK	LNApath	LNAFailed Minor "LNA path Impaired"	< SetGain
6	Impaired	Normal	Broken	LNApath	LNAFailed Minor "LNA path Impaired"	< SetGain
7	Impaired	Bypass	OK	BypassPath	LNAFailed Minor "LNA path Impaired"	< 0 dB
8	Impaired	Bypass	Broken	LNApath	LNAFailed Minor "LNA Path Impaired" BypassPath Minor "Bypass path failed"	< SetGain
9	Broken	Normal (Mode selection not applicable)	Bypass not supported	None	NoRXConnection Major "LNA path Broken"	<< 0 dB
10	Broken	Any	OK	BypassPath	LNAFailed Major "LNA path Broken"	< 0 dB
11	Broken	Any	Broken	None	NoRXConnection Major "LNA Path Broken"	<< 0 dB

Table A-1: TMA State IDs