



***Tower Mounted Amplifier
AISG-ST-TMA
vTMA3.0.5.2***

Revision History

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

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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.

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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.

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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"

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4. VERSION COMPLIANCE (Informative)

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

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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	3 rd Generation Partnership Project

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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.

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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
```

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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
```

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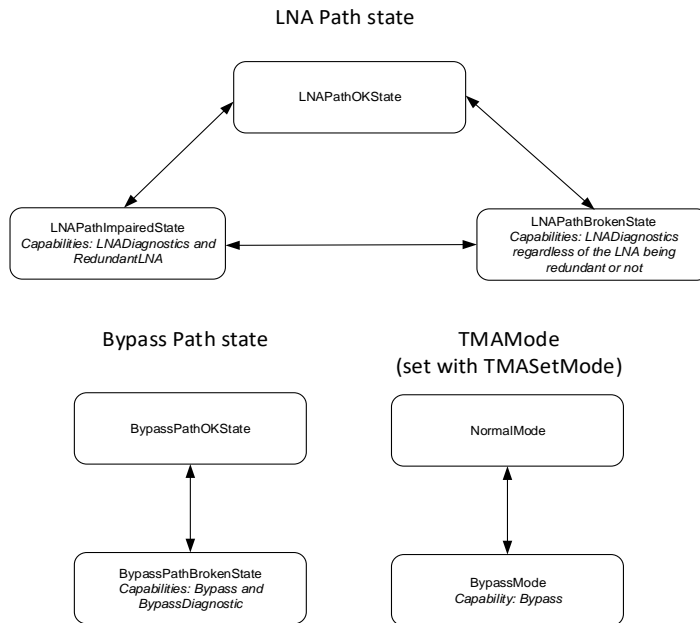


Figure 8.2.1-1 Input to TMAState state model

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.

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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:

- TMA Mode
- TMA Gain

After reset, TMA shall perform EvaluateTMAState function.

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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.

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10. LAYER 2

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

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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

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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 LNAAAlarm
AlarmDetails_t BypassAlarm
AlarmDetails_t RxConnectionAlarm

LNAAAlarm.Severity ← Cleared
LNAAAlarm.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
```


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```
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
```

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```
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
```

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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
    InvalidSubunitType
    // The following are return codes from command pseudocode below
    NotAuthorised
    NotAControlPort
    IncorrectState
    Busy
    InUseByAnotherPrimary
    OK
}
```

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Primary pseudocode:

(This section is intentionally left blank)

ALD pseudocode:

```
IF ALDType = MALD
    AND ActiveAuth[CurrentPort].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
}
```

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```
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
    InvalidSubunitType
    // The following are return codes from command pseudocode below
    UnsupportedCapability
    UnsupportedValue
    NotAuthorised
    NotAControlPort
    IncorrectState
    Busy
    InUseByAnotherPrimary
    OK
}
```

Primary pseudocode:

(This section is intentionally left blank)

ALD pseudocode:

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

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

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

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```
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
    }
}
```

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```
Enumeration ReturnCode_t {
    // The following are return codes from command message validation (see section
    // 12.6.2 in [1])
    FormatError
    UnknownCommand
    InvalidSubunitNumber
    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:

```
IF ALDType = MALD
    AND ActiveAuth[CurrentPort].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.

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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
    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:

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

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


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```
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.

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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
    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:

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

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```
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
```

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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