



***Tower Mounted Amplifier
AISG-ST-TMA
vTMA3.0.1.0***

Revision History

DATE	ISSUE	NOTES
5 th November 2018	vTMA3.0.0.6	First public release.
6 th February 2019	vTMA3.0.1.0	Public release #2

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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).

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.

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

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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

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

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5. ABBREVIATIONS

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:

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.
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 TMARequestedMode
```

```
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 dB_t TMARequestedGain
```

```
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
```

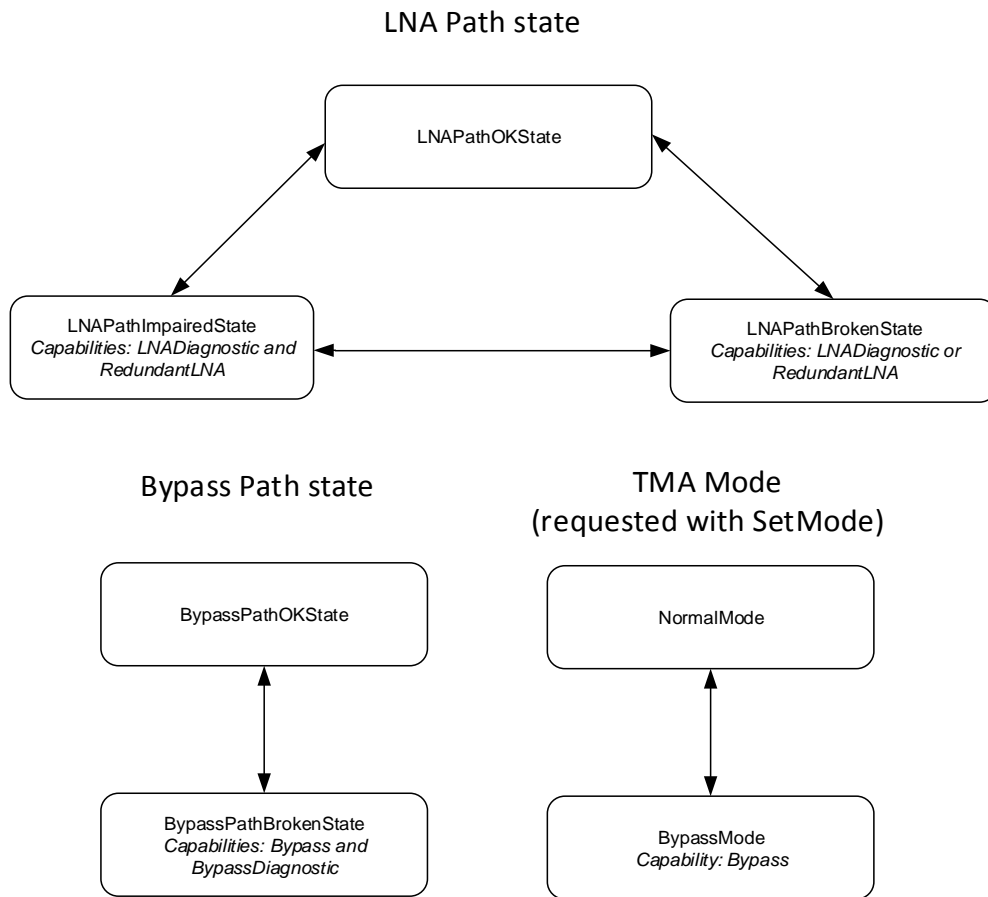


Figure 8.2.1-1 Input to TMAState state model

8.3. TMA capabilities

The TMACapabilities bitfield 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
}
TMACapabilities_t TMACapabilities
  
```

8.4. Return codes

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

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```
Enumeration ReturnCode_t : uint16_t {
    TMAUnsupportedGainValue ← 0x0200
    TMAMajorFault          ← 0x0201
    TMAMinorFault          ← 0x0202
    TMANotPredictableGain ← 0x0203
}
```

8.5. Resumption of operation

The following data shall be retained after reset:

- TMARequestedMode
- TMARequestedGain

After reset, TMA shall perform TMAEvaluateState 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 TMARequestedMode = 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:
        LNAAAlarm.Severity ← Minor
        LNAAAlarm.DiagnosticString ← "LNA path impaired"
        IF TMARequestedMode = 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
        ENDIF
    ELSE
        TMAActivePath ← LNAPath
    ENDIF
ENDCASE
```


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```

        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
```

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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.

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

Message format (Normative):

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

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```
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[NrOfGainRanges]
        uint8_t            NrOfFrequencyRanges
        FrequencyRange_t  Ranges[NrOfFrequencyRanges] // see chapter 13 in [1]
    }
    else {
        ALDState_t        ALDState
        ConnectionState_t  ConnectionState
    }
}

Enumeration ReturnCode_t {
    OK
    FormatError
    Busy
    InvalidSubunitNumber
    InvalidSubunitType
    IncorrectState
    UnknownCommand
    NotAuthorised
}
```

Primary pseudocode (Normative):

(This section is intentionally left blank)

ALD pseudocode (Normative):

```
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
```

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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 (Normative):

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

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 {
    OK
    FormatError
    Busy
    IncorrectState
    InvalidSubunitNumber
    InvalidSubunitType
    UnknownCommand
    NotAuthorised
    UnsupportedCapability
    UnsupportedValue
}
```

Primary pseudocode (Normative):

(This section is intentionally left blank)

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ALD pseudocode (Normative):

```
UNLESS TMACapabilities.Bypass THEN
    RETURN UnsupportedCapability
    EXIT
ELSEIF Cmd.TMAMode ≠ NormalMode AND Cmd.TMAMode ≠ 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)
UNLESS result.allowed THEN
    RETURN result.code
    EXIT
ENDIF
IF TMARequestedMode ≠ TMAMode THEN
    TMAMode ← TMARequestedMode
    EvaluateTMAState(Cmd.Subunit)
ENDIF
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 in NormalMode or in BypassMode. TMA subunits which do not support BypassMode shall return NormalMode.

Message format (Normative):

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

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

Enumeration ReturnCode_t {
    OK
    FormatError
    Busy
    InvalidSubunitNumber
    InvalidSubunitType
    IncorrectState
    UnknownCommand
    NotAuthorised
}
```

Primary pseudocode (Normative):

(This section is intentionally left blank)

ALD pseudocode (Normative):

```
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
```

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

11.5.4. TMA Set Gain

Description (Informative):

On receipt of the command (if supported), the ALD shall first set the addressed TMA subunit to the gain determined by the TMA gain figure parameter, and then return the response message. The TMA gain figure parameter is calculated as 10 times the required gain expressed in dB. This encoding allows the gain to be set with a resolution of 0.1 dB while using an integer parameter.

If the TMA subunit is set in bypass mode by TMASetMode, and TMASetGain is received, then the procedure shall be performed and 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 (Normative):

```
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 {
    OK
    FormatError
    Busy
    IncorrectState
    InvalidSubunitNumber
    InvalidSubunitType
    TMAUnsupportedGainValue
    UnknownCommand
    NotAuthorised
    TMAMajorFault
    TMAMinorFault
}
```

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Primary pseudocode (Normative):

(This section is intentionally left blank)

ALD pseudocode (Normative):

```
IF ALDType = MALD THEN
    UNLESS ActiveAuth[CurrentPort].Authority[Cmd.Subunit] = ReadWrite THEN
        RETURN NotAuthorised
    EXIT
    ENDF
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 0 TO NrOfGainRanges -1 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
        TMARequestedGain ← Cmd.Gain
        RETURN OK
    ELSE
        RETURN TMAUnsupportedGainValue
    ENDF

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


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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 set gain of the TMA subunit. EstimatedGain is used to represent the actual gain. In NormalMode without a TMA fault, the EstimatedGain shall be equal to the SetGain. In BypassMode and in case of a TMA fault in NormalMode, the EstimatedGain shall be a prediction of the actual LNA gain.

Message format (Normative):

```
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          SetGain
        ddB_t          EstimatedGain
        TMAMode_t      TMAMode
    }
    else {
        ALDState_t     ALDState
        ConnectionState_t  ConnectionState
    }
}

Enumeration ReturnCode_t {
    OK
    FormatError
    Busy
    IncorrectState
    InvalidSubunitNumber
    InvalidSubunitType
    UnknownCommand
    NotAuthorised
    TMANotPredictableGain
}
```

Primary pseudocode (Normative):

(This section is intentionally left blank)

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ALD pseudocode (Normative):

```
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

IF «gain can be determined» THEN           // This is defined by the
                                           // vendor
    RETURN OK, EstimatedGain, TMAMode
ELSE
    RETURN TMANotPredictableGain
ENDIF
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