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Application Note

Multimedia Processor for Mobile Applications

ITU-R BT.656 Interface

EMMA Mobile 1

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PREFACE

Purpose The purpose of this document is to introduce the usage of EMMA Mobile 1 ITU-R BT.656 (NTS) interface.

Organization This document includes the following:

- Chapter 1. Overview
- Chapter 2. Usage of NTS Interface
- Chapter 3. Sample of NTS Operation
- Appendix NTS Driver Function

Notation Here explains the meaning of following words in text:

Note Explanation of item indicated in the text

Caution Information to which user should afford special attention

Remark Supplementary information

Related document The following tables list related documents.

Reference Document

Document Name	Version/date	Author	Description
S19268EJ1V0UM00_1chip.pdf	1 st edition	NECEL	User's Manual
S19265EJ1V0UM00_ASMUGIO.pdf	1 st edition	NECEL	User's Manual
S19257EJ1V0UM00_ITU-R.pdf	1 st edition	NECEL	User's Manual
S19907EJ1V0AN00_GD.pdf	1 st edition	NECEL	GD Spec
S19901EJ1V0AN00_SPI.pdf	1 st edition	NECEL	Application Note
S19905EJ1V0AN00_I2C.pdf	1 st edition	NECEL	Application Note
ADV7179KCP.pdf	Rev. A	Analog Devices	Specification

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Chapter 1 Overview

1.1 Introduction

In this document, the below contents of EMMA Mobile 1 ITU-R BT.656 (NTS) interface will be described.

- 1) the normal process procedure of NTS interface
- 2) usage sample of NTS

As additional, the EMMA Mobile 1 NTS driver interface of EMMA Mobile 1 evaluation program will be explained.

About detail of NTS interface, please refer to “**EMMA Mobile 1 ITU-R BT.656 Interface User’s Manual**”.

1.2 Development Environment

- Hardware environment of this project is listed as below.

Table 1-1 Hardware Environment

Name	Version	Maker
EMMA Mobile 1 evaluation board (PSKCH2Y-S-0016-01)	-	NEC Electronics
PARTNER-Jet ICE ARM	M20	Kyoto Microcomputer Co. Ltd

- Software used in this project is listed as below.

Table 1-2 Software Environment

Name	Version	Maker
GNUARM Toolchain	V4.3.2	GNU
WJETSET-ARM	V5.10a	Kyoto Microcomputer Co. Ltd

Chapter 2 Usage of NTS Interface

EMMA Mobile 1 NTS interface supports 2 standards: NTSC and PAL.

Operation flows of NTS interface:

- 1) fetches YUV422 image data from a frame buffer;
- 2) converts it to ITU-R BT.656-compliant parallel data;
- 3) outputs to an external NTSC/PAL encoder IC

2.1 Normal Procedure of NTS Operation

Normal NTS operation procedure is shown as below.

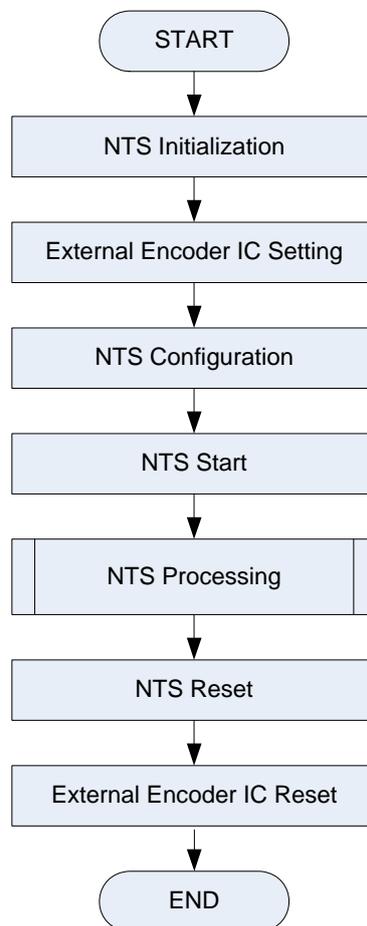


Figure 1-1 Normal NTS Operation Flow

2.2 Detail of Normal NTS Operation Procedure

2.2.1 NTS Initialization

When do NTS initializations, unreset NTS clock by setting ASMU register as below. It's necessary to switch the alternate pin to NTS function.

Related register:

```

RESETREQ0;
RESETREQ0ENA;
AHBCLKCTRL0;
APBCLKCTRL0;
GCLKCTRL2;
GCLKCTRL2ENA;
CHG_PINSEL_G64;
CHG_PINSEL_G80;
CHG_PULL_G08;

```

Explanation:

GIO P72 ~ P81 are alternated with NTS and other modules.

When switch the alternate pins to NTS function:

bit [31:16] of the register "CHG_PINSEL_G64" are set to "01 01 01 01 01 01 01 01";

bit [5:0] of the register "CHG_PINSEL_G80" are set to "01 01 01".

GIO P72 is alternated with NTS_CLK pin.

For NTS clock setting, configure "CHG_PULL_G72" as below:

Signal	Setting	Function
IE	1	Allows input
UPC	0	Not care
POENB	1	Disable Pull-Up/Down

Note:

1. More detail about the CHG registers, please refer to "**EMMA Mobile 1 One Chip User's Manual**".
2. About the explanation of all the ASMU registers mentioned in this document, please refer to "**EMMA Mobile 1 ASMU/GIO Interface User's Manual**".

2.2.2 Configure the External Encoder IC

Configure the external encoder IC according to its' specification or user's manual.

2.2.3 Configure NTS module

NTS interface supports PAL mode and NTSC mode. So configure the NTS module according to the specified output mode;

Set NTS interrupt register as necessary.

Related registers:

NTS_CONTROL;
 NTS_FRAMESEL;
 NTS_YAREAAD_A/B/C;
 NTS_UVAREAAD_A/B/C;
 NTS_HOFFSET;
 NTS_INTENCLR;
 NTS_FFCLR;
 NTS_INTENSET;

2.2.4 Start NTS Processing

Start NTS processing by setting NTS_OUT to the not-0 value.

Different setting value performs the different output mode.

Note:

Name	Setting	Function
NTS_OUT	00b	Output OFF (all-0 data is output)
	01b	Blackback output
	10b	Blueback output
	11b	Normal output

2.2.5 NTS Processing

After start the NTS processing, the source data are fetched and converted to the NTS compliant parallel data. Then output to the external encoder NTSC/PAL IC.

2.2.6 NTS Reset

Reset NTS interface by setting the related ASMU registers, when exit from NTS function.

Related register:

RESETREQ0;
RESETREQ0ENA;
AHBCLKCTRL0;
APBCLKCTRL0;
GCLKCTRL2;
GCLKCTRL2ENA;

2.2.7 Reset the External Encoder IC

It's also necessary to reset and power off the external NTSC/PAL encoder IC, when exit from NTS function.

About the reset operation of the external encoder IC, please refer to its' specification or user's manual.

Chapter 3 Sample of NTS Operation

3.1 Outline of NTS Operation Sample

On EMMA Mobile 1 evaluation board (PSKCH2Y-S-0016-01), ADV7179 (manufacture: ANALOG DEVICES) is connected as the external NTSC/PAL encoder IC.

For show the usage of NTS interface with ADV7179, the below 2 samples are performed.

- NTSC mode; (NTSC and ADV7179 output)
- PAL mode; (PAL and ADV7179 output)

In the NTS samples, the data is transmitted as below:

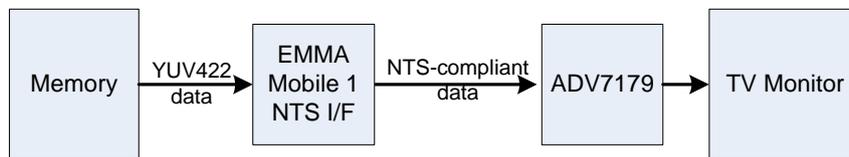


Figure 3-1 Data Flow Chart of NTS Samples

As shown in the figure, EMMA Mobile 1 NTS will fetch the source YUV422 image data, and convert to NTS compliant data, then output to ADV7179.

1 set of TV monitor is connected to display the processed data via ADV7179.

Caution:

Please make sure all hardware for NTS interface are on READY status, before perform the NTS samples.

3.2 Operation Flow of NTS Example

Operation flow chart of the NTS sample is shown as below.

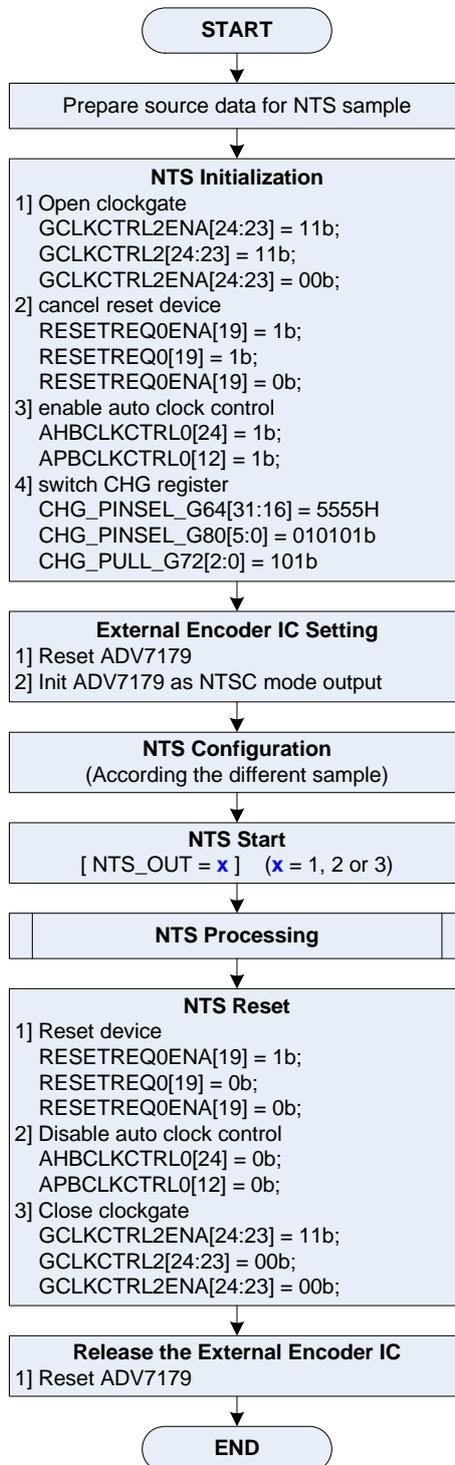


Figure 3-2 Operation Flow of NTS Sample

3.3 Detail of NTS Sample

3.3.1 Prepare Source Data for NTS Sample

Load YUV422 data to frame A and frame B for NTS sample.

Data stored in frame A is prepared for NTSC sample;

Data stored in frame B is prepared for PAL sample.

3.3.2 NTS Initialization

Set ASMU and CHG registers, as listed in figure 3-2.

3.3.3 ADV7179 Setting

Reset and Initialize ADV7179.

Reset ADV7179 by call SPI0 driver interface:

- 1) Initialize EMMA Mobile 1 SPI0 interface
- 2) Set GPIO10 of PMIC (reset pin) to output mode
- 3) Make GPIO10 output '0' and wait for stable
- 4) Make GPIO10 output '1'

Initialize ADV7179 by call SPI0 and I2C driver interface:

- 1) Initialize EMMA Mobile 1 I2C interface
- 2) Enable power output for ADV7179
- 3) Set ADV7179 with the default value of NTSC mode

Note:

Detail of SPI0 driver interface, please refer “EMMA Mobile 1 SPI Application Note”.

Detail of I2C driver interface, please refer “EMMA Mobile 1 I2C Application Note”.

3.3.4 NTS Configuration

For different sample, the configuration is different.

Table 3-1 Configuration of NTS Sample

Sample	Module	Register	Setting
NTSC	NTS I/F	NTS_CONTROL	= 0; { UPSCALE = 0b: disable upscale function ; OUTMODE = 0b: NTSC mode ; CLKPOL = 0b: rising edge of NTS_CLKI ; ENDIAN = 0b: Little endian ; }
		NTS_YAREAAD_A	= 0x3100_0000
		NTS_UVAREAAD_A	= 0x3110_0000
		NTS_HOFFSET	= 720
	NTS_FRAMESEL	= 1 { AREASEL = 01b: frame buffer A ; }	
	ADV7179	Set ADV7179 registers with NTSC setting values (^{NOTE}), please refer Table 3-2	
PAL	NTS I/F	NTS_CONTROL	= 4; { UPSCALE = 0b: disable upscale function ; OUTMODE = 1b: PAL mode ; CLKPOL = 0b: rising edge of NTS_CLKI ; ENDIAN = 0b: Little endian ; }
		NTS_YAREAAD_A	= 0x3120_0000
		NTS_UVAREAAD_A	= 0x3130_0000
		NTS_HOFFSET	= 720
	NTS_FRAMESEL	= 2 { AREASEL = 10b: frame buffer B ; }	
	ADV7179	Set ADV7179 registers with PAL setting values (^{NOTE}), please refer Table 3-2	

Note:

1. Default setting value sequence of ADV7179 for NTSC/PAL mode are listed in the below table.

Table 3-2 Default Setting Value of ADV7179 for NTSC/PAL Mode

ADV7179 Register		Mode	
Name	Address	NTSC	PAL
Mode Register 0 [MR0]	00	0x00	0x05
Mode Register 1 [MR1]	01	0x10	0x10
Mode Register 2 [MR2]	02	0x00	0x00
Mode Register 3 [MR3]	03	0x00	0x00
Mode Register 4 [MR4]	04	0x10	0x00
Reserved	05	0x00	0x00
Reserved	06	0x00	0x00
Timing Mode Register 0 [TR0]	07	0x00	0x00
Timing Mode Register 1 [TR1]	08	0x00	0x00
Subcarrier Freq Reg 0	09	0x1E	0xCB
Subcarrier Freq Reg 1	0A	0x7C	0x8A
Subcarrier Freq Reg 2	0B	0xF0	0x09
Subcarrier Freq Reg 3	0C	0x21	0x2A
Subcarrier Phase Reg	0D	0x00	0x00
Closed Captioning Ext Data Byte 0	0E	0x00	0x00
Closed Captioning Ext Data Byte 1	0F	0x00	0x00
Closed Captioning Data Byte 0	10	0x00	0x00
Closed Captioning Data Byte 1	11	0x00	0x00
NTSC Pedestal Ctrl Reg 0 / PAL TTX Ctrl Reg 0	12	0x00	0x00
NTSC Pedestal Ctrl Reg 1 / PAL TTX Ctrl Reg 1	13	0x00	0x00
NTSC Pedestal Ctrl Reg 2 / PAL TTX Ctrl Reg 2	14	0x00	0x00
NTSC Pedestal Ctrl Reg 3 / PAL TTX Ctrl Reg 3	15	0x00	0x00
CGMS_WSS_0 [C/W0]	16	0x00	0x00
CGMS_WSS_1 [C/W1]	17	0x00	0x00
CGMS_WSS_2 [C/W2]	18	0x00	0x00
TeleText Request Ctrl Reg [TC07]	19	0x00	0x00

More detail about ADV7179 registers, please refer “**ADV7179 Specification**”.

3.3.5 Start NTS Processing

Start NTS processing by setting “NTS_OUT” with not-0 value.

For NTSC and PAL sample, set the register to “3”; it is normal output mode.

3.3.6 NTS Processing

After start the NTS processing, the source data are fetched and converted to the NTS compliant parallel data. Then output to ADV7179. It will be displayed in the connected TV monitor finally.

3.3.7 NTS Reset

After complete NTS NTSC and PAL function evaluation, reset NTS interface by setting ASMU registers as listed in figure 3-2.

3.3.8 Release ADV7179

Reset and power off ADV7179 as the below sequence.

- 1) Initialize SPI0
- 2) Set GPIO10 of PMIC (reset pin) to output mode
- 3) Make GPIO10 output '0'

3.4 ADV7179 Color Bar Function

As additional, ADV7179 color bar function is evaluated as an individual sample.

It will generate and output an internal color bar test pattern. It is important to note that when color bars are enabled, the ADV7179 is configured in a master timing mode.

Under this sample, ADV7179 is used only. So the operations of NTS are unnecessary.

Operation of this sample is as below:

- 1) ADV7179 Setting
Same with "[3.3.3 ADV7179 Setting](#)"
- 2) Set ADV7179 to color bar mode
Set bit[7] of ADV7179 Mode Register 1 with "1", to enable color bar function.
- 3) Check the color bar pattern displayed in TV monitor
- 4) Reset and power off ADV7179
Same with "[3.3.8 Release ADV7179](#)".

Appendix A. NTS Driver Function

A.1 NTS API function list

The following table shows the NTS interface functions:

Table A-1 NTS Driver Function List

Type	Function Name	Function Detail
Driver Function	em1_nts_init	Initialize NTS interface
	em1_nts_release	Release NTS interface
	em1_nts_setup	Configure NTS interface
	em1_nts_start	Start NTS processing
	em1_nts_irq_enable	Enable NTS Interrupt
	em1_nts_irq_handle	NTS Interrupt handler

A.2 Type Define

A.2.1 Naming rule and coding rule

About naming rule and coding rule, please refer to “GD_SPEC_EM1_AN&TP.pdf”

A.2.2 Structure

Table A-2 Structure Define

Structure Name	Structure Member
NTS_SETUP_ST	uchar upscale
	uchar outmode
	uint clkpol
	uint endian
	uint buffer_a_y
	uint buffer_b_y
	uint buffer_c_y
	uint buffer_a_uv
	uint buffer_b_uv
	uint buffer_c_uv
	uint hoffset
	uint frame_sel

A.3 Function Detail

A.3.1 Initialization Function

[Function Name]

em1_nts_init

[Format]

void em1_nts_init(void);

[Argument]

None

[Function Return]

None

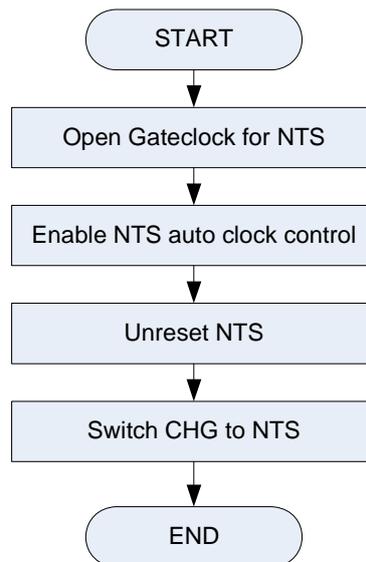
[Function Flow]

Figure A-1 NTS Initialization

[Note]

None

A.3.2 Release Function

[Function Name]

em1_nts_release

[Format]

```
void em1_nts_release(void);
```

[Argument]

None

[Function Return]

None

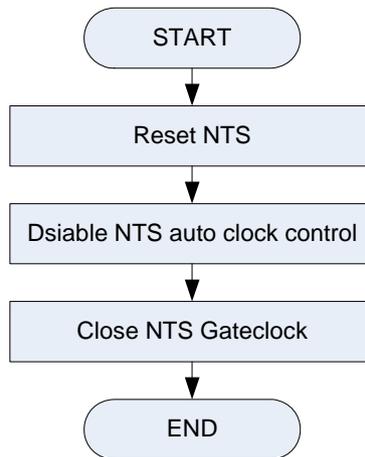
[Function Flow]

Figure A-2 NTS Release

[Note]

None

A.3.3 Setup Function

[Function Name]

em1_nts_setup

[Format]

DRV_RESULT em1_nts_setup (NTS_SETUP_ST* nts_st);

[Argument]

Parameter	Type	I/O	Detail
nts_st	NTS_SETUP_ST *	I	All necessary setting for NTS

[Function Return]

DRV_ERR_PARAM;

DRV_OK;

[Function Flow]

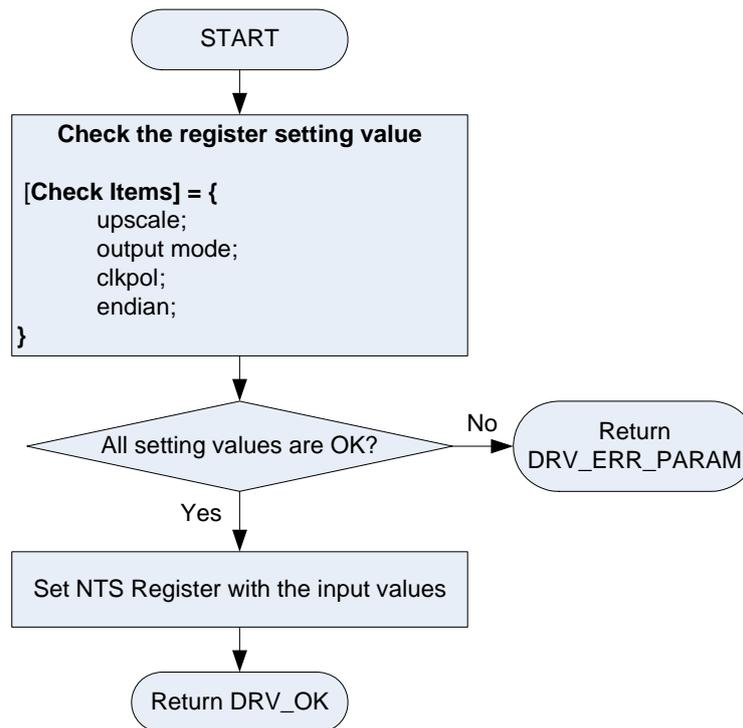


Figure A-3 NTS Setup

[Note]

None

A.3.4 Start Function

[Function Name]

em1_nts_start

[Format]

```
void em1_nts_start(uint display_mode);
```

[Argument]

Parameter	Type	I/O	Detail
display_mode	uint	I	output mode : OFF; Blackback; Blueback; Normal;

[Function Return]

None

[Function Flow]

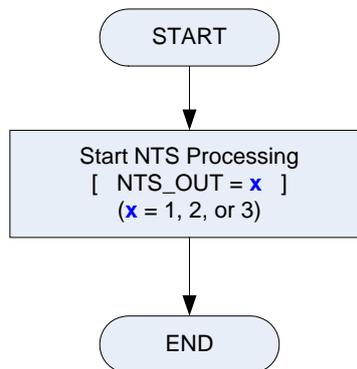


Figure A-4 NTS Start

[Note]

None

A.3.5 INT Enable Function

[Function Name]

em1_nts_irq_enable

[Format]

```
void em1_nts_irq_enable(void);
```

[Argument]

None

[Function Return]

None

[Function Flow]

None

[Note]

None

A.3.6 INT Handler Function

[Function Name]

em1_nts_irq_handle

[Format]

```
void em1_nts_irq_handle(void);
```

[Argument]

None

[Function Return]

None

[Function Flow]

None

[Note]

None

