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April 1<sup>st</sup>, 2010  
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## **Preliminary Application Note**

# **V850E/IF3, V850E/IG3**

**32-bit Single-Chip Microcontrollers**

**Sample Programs for Serial Communication (UARTA)**

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**V850E/IF3:**

***μ*PD70F3451**

***μ*PD70F3452**

**V850E/IG3:**

***μ*PD70F3453**

***μ*PD70F3454**

[MEMO]

① **VOLTAGE APPLICATION WAVEFORM AT INPUT PIN**

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between  $V_{IL}$  (MAX) and  $V_{IH}$  (MIN) due to noise, etc., the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between  $V_{IL}$  (MAX) and  $V_{IH}$  (MIN).

② **HANDLING OF UNUSED INPUT PINS**

Unconnected CMOS device inputs can be cause of malfunction. If an input pin is unconnected, it is possible that an internal input level may be generated due to noise, etc., causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using pull-up or pull-down circuitry. Each unused pin should be connected to  $V_{DD}$  or GND via a resistor if there is a possibility that it will be an output pin. All handling related to unused pins must be judged separately for each device and according to related specifications governing the device.

③ **PRECAUTION AGAINST ESD**

A strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it when it has occurred. Environmental control must be adequate. When it is dry, a humidifier should be used. It is recommended to avoid using insulators that easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors should be grounded. The operator should be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with mounted semiconductor devices.

④ **STATUS BEFORE INITIALIZATION**

Power-on does not necessarily define the initial status of a MOS device. Immediately after the power source is turned ON, devices with reset functions have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. A device is not initialized until the reset signal is received. A reset operation must be executed immediately after power-on for devices with reset functions.

⑤ **POWER ON/OFF SEQUENCE**

In the case of a device that uses different power supplies for the internal operation and external interface, as a rule, switch on the external power supply after switching on the internal power supply. When switching the power supply off, as a rule, switch off the external power supply and then the internal power supply. Use of the reverse power on/off sequences may result in the application of an overvoltage to the internal elements of the device, causing malfunction and degradation of internal elements due to the passage of an abnormal current.

The correct power on/off sequence must be judged separately for each device and according to related specifications governing the device.

⑥ **INPUT OF SIGNAL DURING POWER OFF STATE**

Do not input signals or an I/O pull-up power supply while the device is not powered. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Input of signals during the power off state must be judged separately for each device and according to related specifications governing the device.

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## INTRODUCTION

- Cautions**
1. This Application Note explains a case where the V850E/IG3 is used as a representative microcontroller. Use this Application Note for your reference when using the V850E/IF3.
  2. Download the program used in this manual from the page of Programming Examples (<http://www.necel.com/micro/en/designsupports/sampleprogram/index.html>) in the NEC Electronics Website (<http://www.necel.com/>).
  3. This sample program is provided for reference purposes only and operations are therefore not subject to guarantee by NEC Electronics Corporation. When using sample programs, customers are advised to sufficiently evaluate this product based on their systems, before use.
  4. When using sample programs, reference the following startup routine and link directive file and adjust them if necessary.
    - Startup routine: `ig3_start.s`
    - Link directive file: `ig3_link.dir`

**Target Readers** This Application Note is intended for users who understand the functions of the V850E/IF3 ( $\mu$ PD70F3451, 70F3452), and V850E/IG3 ( $\mu$ PD70F3453, 70F3454), and who design application systems that use these microcontrollers.

**Purpose** This manual is intended to give users an understanding of the basic functions of the V850E/IF3 and V850E/IG3, using the application programs.

**How to Use This Manual** It is assumed that the reader of this Application Note has general knowledge in the fields of electrical engineering, logic circuits, and microcontrollers.

For details of hardware functions (especially register functions, setting methods, etc.) and electrical specifications

→ See the **V850E/IF3, V850E/IG3 Hardware User's Manual**.

For details of instruction functions

→ See the **V850E1 Architecture User's Manual**.

**Conventions**

Data significance:	Higher digits on the left and lower digits on the right
Active low representation:	$\overline{\text{xxx}}$ (overscore over pin or signal name)
Memory map address:	Higher addresses on the top and lower addresses on the bottom
<b>Note:</b>	Footnote for item marked with <b>Note</b> in the text
<b>Caution:</b>	Information requiring particular attention
<b>Remark:</b>	Supplementary information
Numeric representation:	Binary ... xxxx or xxxxB Decimal ... xxxx Hexadecimal ... xxxxH
Prefix indicating the power of 2 (address space, memory capacity):	K (kilo): $2^{10} = 1,024$ M (mega): $2^{20} = 1,024^2$ G (giga): $2^{30} = 1,024^3$

The function lists are structured as follows.

### Hardware name (symbol)

[Function]	Function description
[Function name]	Name of sample function
[Argument(s)]	Type and overview of argument(s)
[Processing content]	Processing content of sample function
[SFR(s) used]	Register name and setting content
[call function(s)]	Name and function of call function(s)
[Variable(s)]	Type, name, and overview of variable(s) used in sample function
[Interrupt(s)]	Name of function
[Interrupt source(s)]	Name
[File name]	Name of corresponding sample program file
[Caution(s)]	Caution(s) upon function usage

### Interrupt function

[Function name]	Name of interrupt function
[Servicing content]	Servicing content of interrupt function
[SFR(s) used]	Name of interrupt and conditions for occurrence
[call function(s)]	None
[Variable(s)]	Name of variable, function
[File name]	Name of corresponding sample program file
[Caution(s)]	None



## Related Documents

The related documents indicated in this publication may include preliminary versions. However, preliminary versions are not marked as such.

### Documents related to V850E/IF3 and V850E/IG3

Document Name	Document No.
V850E1 Architecture User's Manual	U14559E
V850E/IF3, V850E/IG3 Hardware User's Manual	U18279E
V850E/IF3, V850E/IG3 Sample Programs for Serial Communication (UARTA) Application Note	This manual
V850E/IF3, V850E/IG3 Sample Programs for Serial Communication (UARTB) Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Serial Communication (CSIB) Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Serial Communication (I <sup>2</sup> C) Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for DMA Function Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Timer M Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Watchdog Timer Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Timer AA Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Timer AB Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Timer T Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Port Function Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Clock Generator Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Standby Function Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Interrupt Function Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for A/D Converters 0 and 1 Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for A/D Converter 2 Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Low-Voltage Detector (LVI) Function Application Note	To be prepared
V850E/IF3, V850E/IG3 6-Phase PWM Output Control by Timer AB, Timer Q Option, Timer AA, A/D Converters 0 and 1 Application Note	U18717E

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## CHAPTER 1 CONTINUOUS TRANSMISSION/RECEPTION

[Function]	Performs continuous UARTA0 transmission/reception.
[Function name]	uarta_main
[Argument]	None
[Processing content]	Performs transmission/reception for ten times using UARTA0. Stores received data in buf_rx[], and transmitted data in buf_tx[].
[SFRs used]	<p>UA0REIC: 0x07 (Clears UARTA0 reception error interrupt request signal (INTUA0RE), releases mask, sets to priority level 7.)</p> <p>UA0TIC: 0x07 (Clears UARTA0 transmission enable interrupt request signal (INTUA0T), releases mask, sets to priority level 7.)</p> <p>UA0RIC: 0x07 (Clears UARTA0 reception end interrupt request signal (INTUA0R), releases mask, sets to priority level 7.)</p>
[call functions]	uarta_port_set, uarta_set, uarta_start, uarta_send_end, uarta_receive_end, uarta_end
[Variables]	<p>unsigned char buf_tx[]: Transmit data storing buffer</p> <p>unsigned char buf_rx[]: Receive data storing buffer</p> <p>volatile unsigned char count_tx: Transmission count variable</p> <p>volatile unsigned char count_rx: Reception count variable</p> <p>unsigned char count: Transfer data generating variable</p>
[Interrupts]	uarta_int_send, uarta_int_receive, uarta_error
[Interrupt sources]	INTUA0T, INTUA0R, INTUA0RE,
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_port_set
[Processing content]	Sets alternate-function pin to UARTA0 I/O pin.
[SFRs used]	<p>PFC4: 0x03 (Sets TXDA0 output and RXDA0 input.)</p> <p>PFCE4: 0x00 (Sets TXDA0 output and RXDA0 input.)</p> <p>PMC4: 0x03 (Sets TXDA0 output and RXDA0 input.)</p>
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_set
[Processing content]	Sets UARTA0 control register. Sets baud rate to 9,600 (bps).
[SFRs used]	UA0CTL1: 0x03 (Sets baud rate to 9,600 (bps).) UA0CTL2: 0xD0 (Sets baud rate to 9,600 (bps).) UA0OPT0: 0x14 (Sets to ordinary output of transfer data, ordinary input of transfer data.) UA0CTL0: 0x8A (Enables UARTA0 operation, sets to MSB first, and sets odd parity to output, data character length of 8 bits, and stop bit length of 1 bit.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_start
[Processing content]	Enables transmission/reception and writes data to UA0TX register.
[SFRs used]	UA0CTL0.UA0TXE: 1 (Enables transmission operation.) UA0CTL0.UA0RXE: 1 (Enables reception operation.) UA0TX Transmit data register
[call function]	None
[Variables]	unsigned char buf_tx[]: Transmit data storing buffer
[File name]	uarta.c
[Caution]	Set UA0RXE and UA0TXE bits to 1 after setting UA0CTL.UA0PWR bit to 1.

[Function name]	uarta_send_end
[Processing content]	Disables transmission operation.
[SFR used]	UA0CTL0.UA0TXE: 0 (Disables transmission operation.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_receive_end
[Processing content]	Disables reception operation.
[SFR used]	UA0CTL0.UA0RXE: 0 (Disables reception operation.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_end
[Processing content]	Disables operation of UARTA0.
[SFR used]	UA0CTL0.UA0PWR: 0 (Disables operation of UARTA0.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

## Interrupt function

[Function name]	uarta_int_send
[Processing content]	Writes transmit data to transmit data register. Stops transmission operation if number of transmissions and the count value match.
[SFR used]	UA0TX Transmit data register
[call function]	None
[Variables]	unsigned char buf_tx[]: Transmit data storing buffer volatile unsigned char count_tx: Transmission count variable
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_int_receive
[Processing content]	Writes receive data to receive data register.  Stops and disables reception operation if number of receptions and the count value match.
[SFR used]	UA0RX Receive data register
[call function]	None
[Variables]	unsigned char buf_rx[]:           Receive data storing buffer  volatile unsigned char count_rx:   Reception count variable
[File name]	uarta.c
[Caution]	To stop reception operation, set UA0PWR bit to 0 after setting UA0RXE and UA0TXE bits to 0.

[Function name]	uarta_error
[Processing content]	Clears error flag when reception error occurs.
[SFRs used]	UA0STR.UA0PE:    0 (Clears parity error flag.)  UA0STR.UA0FE:    0 (Clears framing error flag.)  UA0STR.UA0OVE:   0 (Clears overrun error flag.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

Figure 1-1. Continuous Transmission/Reception (1/4)

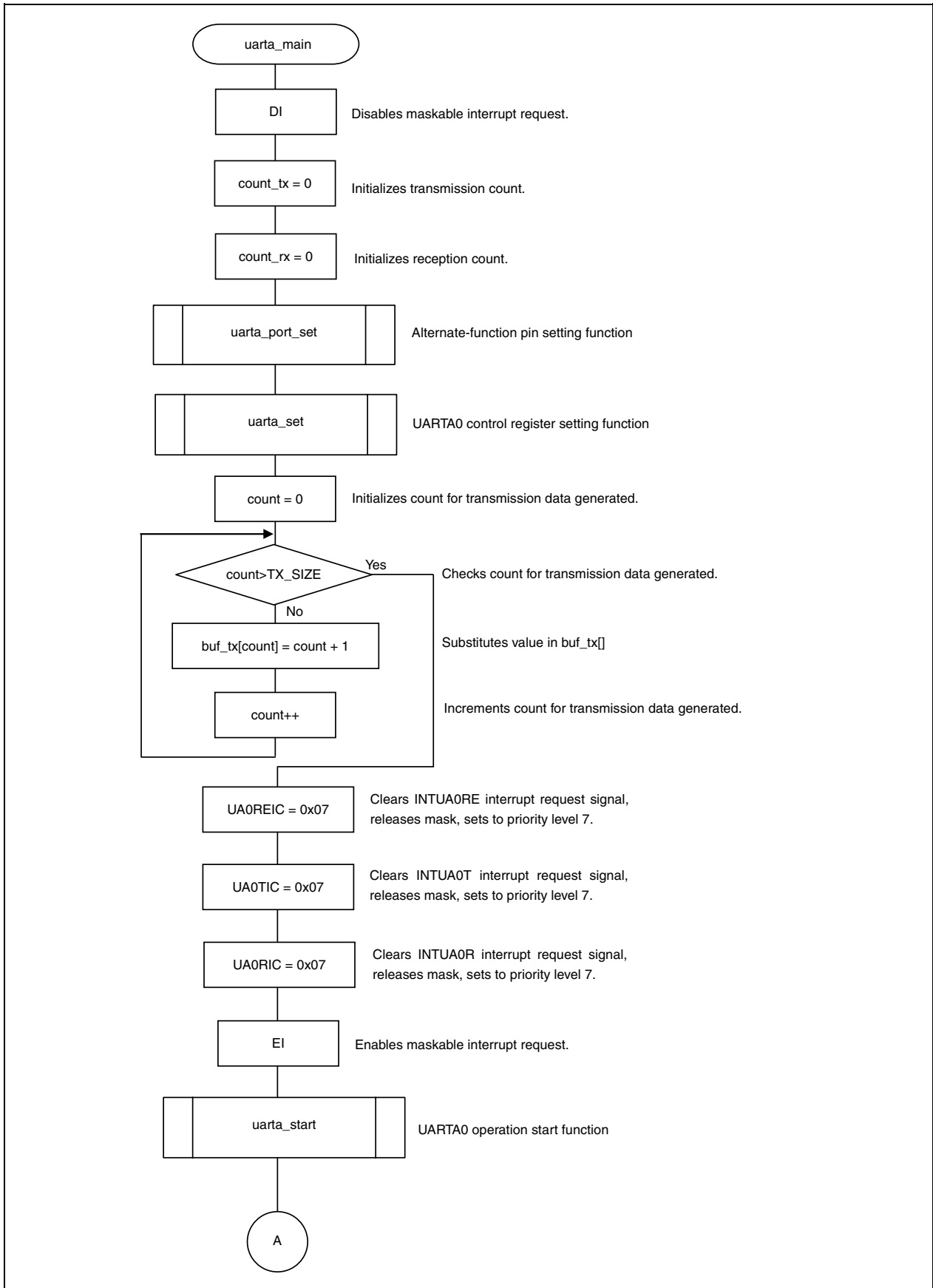


Figure 1-1. Continuous Transmission/Reception (2/4)

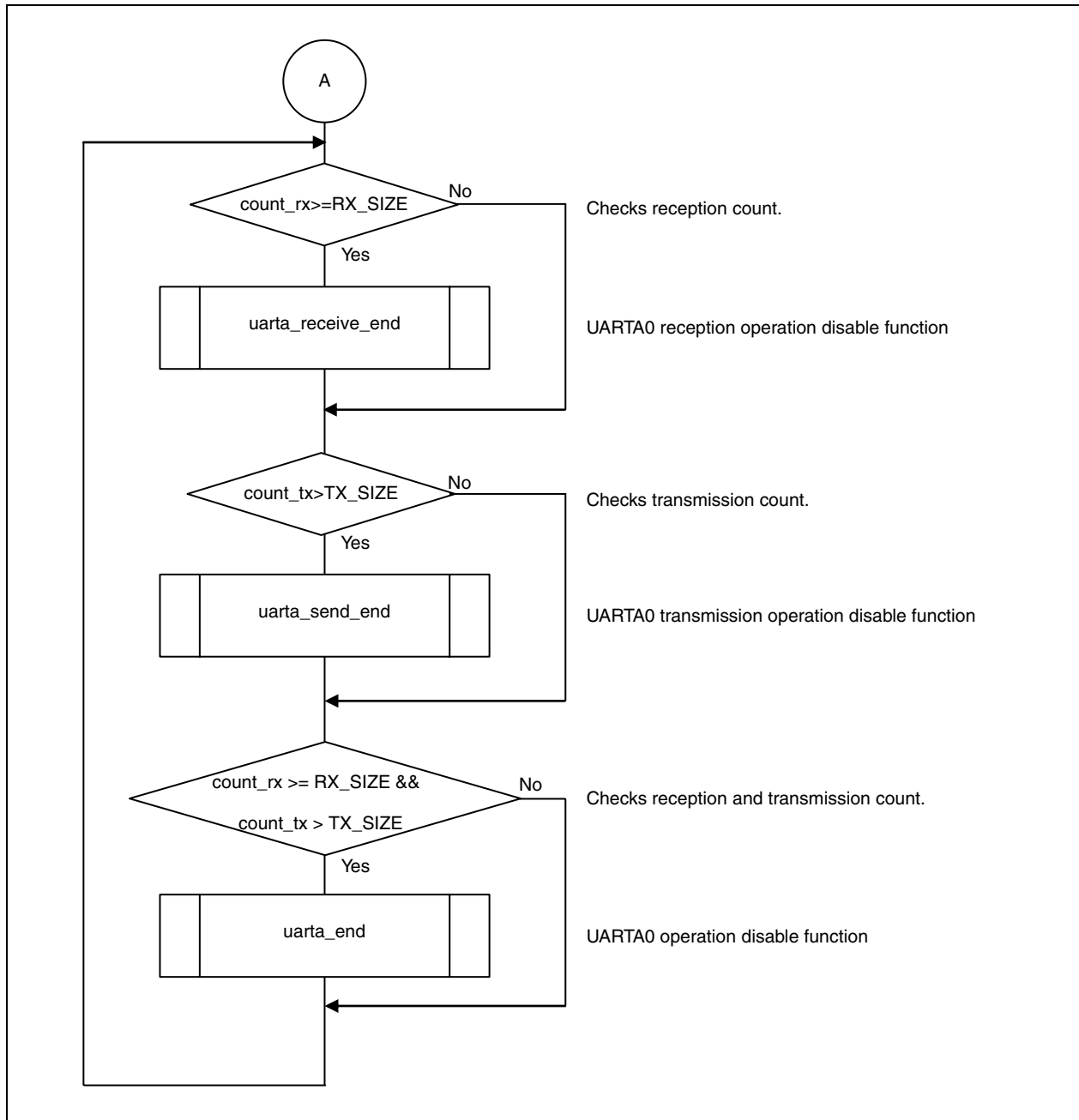




Figure 1-1. Continuous Transmission/Reception (3/4)

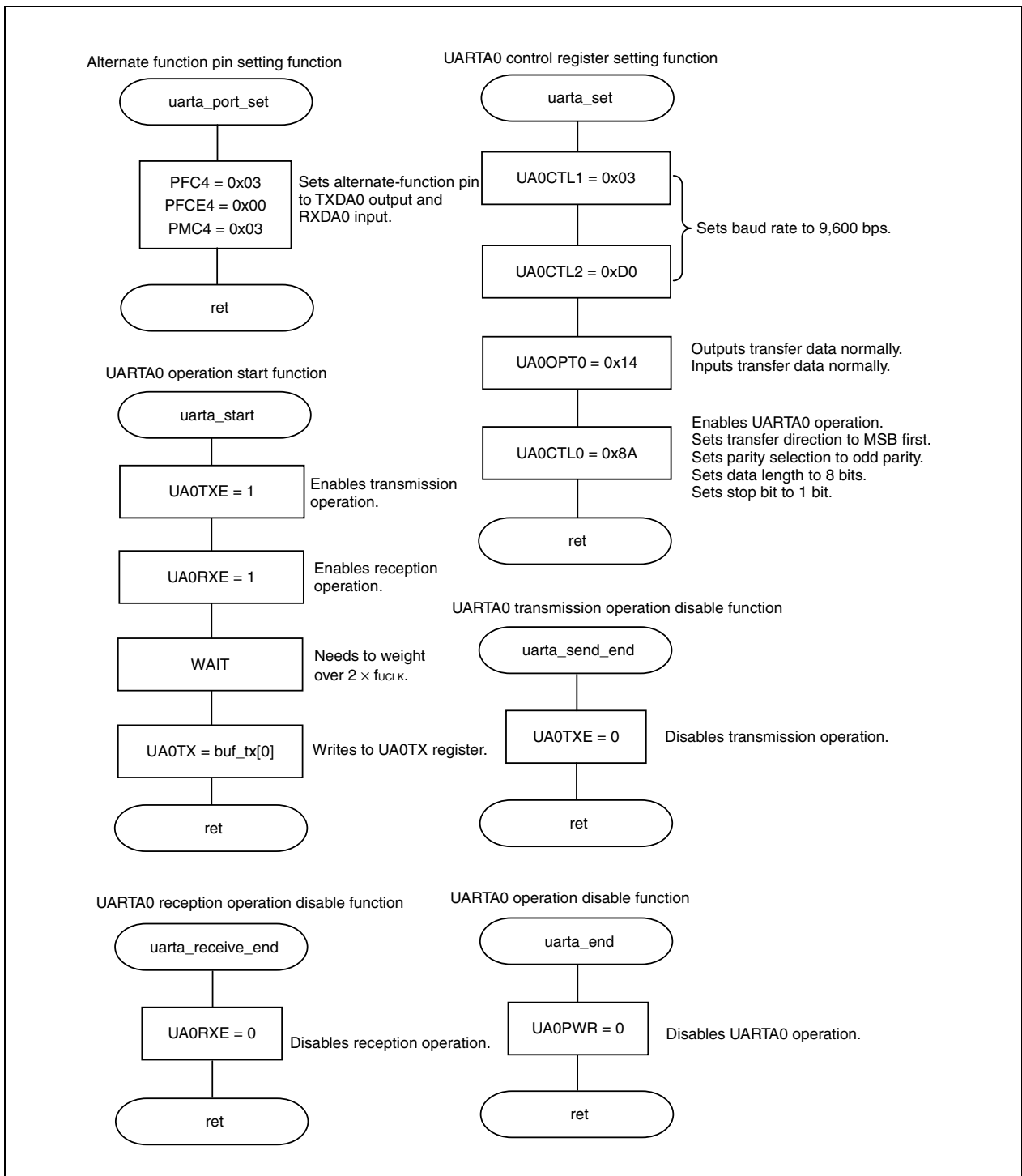
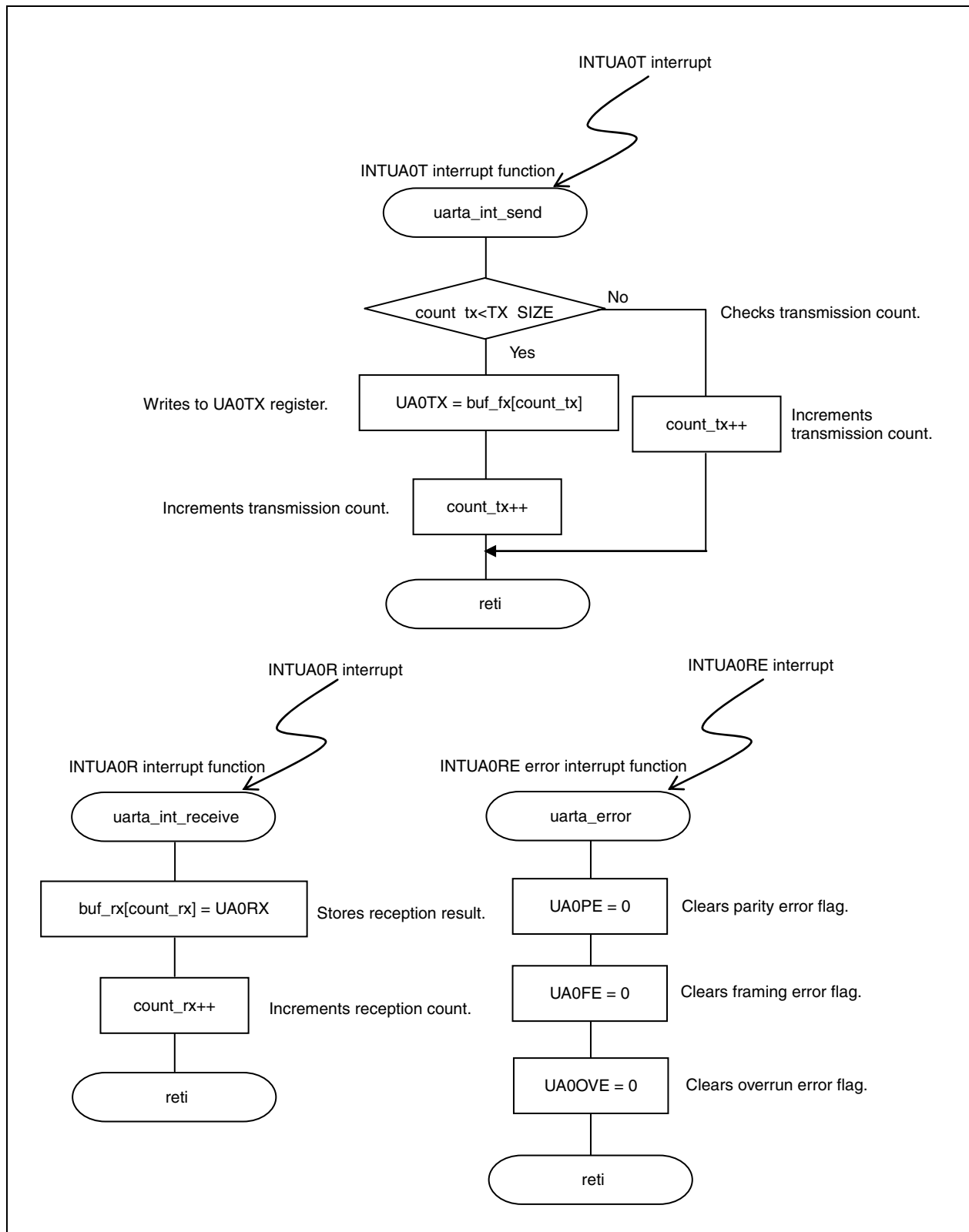


Figure 1-1. Continuous Transmission/Reception (4/4)



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