To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.

GRADE A

MAEC TECHNICAL NEWS

No.M740-27-0111

List of Notes on 7540 Group

Classification	Concerned Products
Corrections and supplementary explanation of document ✔ Notes Knowhow Others	• 7540 Group

Notes on 7540 Group are listed below.

1. Difference between One Time PROM version and MASK ROM version (New) [page 2/10]
2. Difference between general purpose version and automotive version (extended operating temperature version) (New) [page 7/10]
3. Note on A-D converter (New) [page 7/10]
4. Note on 7540 Group Timer Y, Timer Z [page 9/10]
   (Published in June.2001 No.M740-25-0106 Change the revision schedule)
5. Note on 7540 Group Switch of clock [page 10/10]
   (Published in June.2001 No.M740-24-0106)

1.Difference between One Time PROM version and Mask ROM version

There are almost same characteristics between One Time PROM version and mask ROM version in 7540 group. However they have some difference of their characteristics as follows. Please take notice of use.

(1) Difference of electric characteristics

- Absolute Maximum ratings : Input voltage to CNVss pin
  (The rating of the CNVss pin of One Time PROM version is equivalent to the one of writing input signal to the built-in EPROM. Please connect the CNVss pin to Vss for normal operation in One Time PROM version and mask ROM version.)
- Power source current (refer to attached ①)
- A-D converter characteristics (refer to attached ②)

(2) Difference of clock generating circuit and the noise

- The parametric of the external clock circuit needs to be set properly for either One Time PROM version and mask ROM version, when using a ceramic resonator or a quartz-crystal oscillator.
- Please evaluate both One Time PROM version and mask ROM version.
  (Please ask the resonator manufacture about the clock parameter)
- When using a RC oscillation, the parameter of the extended clock circuit may be different between One Time PROM version and mask ROM version.
- Please evaluate both One Time PROM version and mask ROM version.
- The noise immunity and noise emission characteristics on the customer's board, may be different between One Time PROM version and mask ROM version.
- Please evaluate both One Time PROM version and mask ROM version.

(3) Note on use

- Termination of CNVss pin
  One time PROM version: Please make Vss pull-down with a 5 kΩ resistor.
  Mask ROM version: No resistors are needed. No any problem if a resistor is connected to CNVss.

There could be same slightly different between One Time PROM version and mask ROM version, even if the same electric characteristic. Therefore, we strongly suggest that the user's unit would be evaluated well on both One Time PROM version and mask ROM version. Please refer to the note on use of the data sheet.

Attached ① (7540 Group Data Sheet: Page 54)

Electrical Characteristics (General purpose)(continued)

Table 12 Electrical characteristics (2) (Vcc = 2.2 to 5.5 V, Vss = 0 V, Ta = –20 to 85 °C, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits			Unit
				Min.	Typ.	Max.	
Icc	Power source current	One Time PROM version	High-speed mode, f(XIN) = 8 MHz Output transistors "off"		5.0	8.0	mA
			High-speed mode, f(XIN) = 2 MHz, Vcc = 2.2 V Output transistors "off"		0.5	1.5	mA
			Double-speed mode, f(XIN) = 6 MHz Output transistors "off"		6.0	10.0	mA
			Middle-speed mode, f(XIN) = 8 MHz Output transistors "off"		2.0	5.0	mA
			Ring oscillator operation mode, Vcc = 5 V Output transistors "off"		350	1000	µA
			f(XIN) = 8 MHz (in WIT state), functions except timer 1 disabled, Output transistors "off"		1.6	3.2	mA
			f(XIN) = 2 MHz, Vcc = 2.2 V (in WIT state), functions except timer 1 disabled, Output transistors "off"		0.2		mA
			Ring oscillator operation mode, Vcc = 5V (in WIT state), functions except timer 1 disabled, Output transistors "off"		150	450	µA
			Increment when A-D conversion is executed f(XIN) = 8 MHz, Vcc = 5 V		0.5		mA
			All oscillation stopped (in STP state) Output transistors "off" — Ta = 25 °C		0.1	1.0	µA
			All oscillation stopped (in STP state) Output transistors "off" — Ta = 85 °C			10	µA
		Mask ROM version	High-speed mode, f(XIN) = 8 MHz Output transistors "off"		3.5	6.5	mA
			High-speed mode, f(XIN) = 2 MHz, Vcc = 2.2 V Output transistors "off"		0.4	1.2	mA
			Double-speed mode, f(XIN) = 6 MHz Output transistors "off"		4.5	8.0	mA
			Middle-speed mode, f(XIN) = 8 MHz Output transistors "off"		2.0	5.0	mA
			Ring oscillator operation mode, Vcc = 5 V Output transistors "off"		300	900	µA
			f(XIN) = 8 MHz (in WIT state), functions except timer 1 disabled, Output transistors "off"		1.6	3.2	mA
			f(XIN) = 2 MHz, Vcc = 2.2 V (in WIT state), functions except timer 1 disabled, Output transistors "off"		0.2		mA
			Ring oscillator operation mode, Vcc = 5V (in WIT state), functions except timer 1 disabled, Output transistors "off"		150	450	µA
			Increment when A-D conversion is executed f(XIN) = 8 MHz, Vcc = 5 V		0.5		mA
			All oscillation stopped (in STP state) Output transistors "off" — Ta = 25 °C		0.1	1.0	µA
			All oscillation stopped (in STP state) Output transistors "off" — Ta = 85 °C			10	µA

_____ : Underlined part is added in this news.

Attached ① (7540 Group Data Sheet: Page 65)

Electrical Characteristics (Extended operating temperature version)(continued)

Table 25 Electrical characteristics (2) (V_{CC} = 2.4 to 5.5 V, V_{SS} = 0 V, Ta = –40 to 85 °C, unless otherwise noted)

Symbol	Test conditions		Limits			Unit
			Min.	Typ.	Max.	
I_{CC}	High-speed mode, f(X_{IN}) = 8 MHz Output transistors "off"			3.5	6.5	mA
	High-speed mode, f(X_{IN}) = 2 MHz, V_{CC} = 2.4 V Output transistors "off"			0.4	1.2	mA
	Double-speed mode, f(X_{IN}) = 6 MHz, V_{CC} = 5 V Output transistors "off"			4.5	8.0	mA
	Middle-speed mode, f(X_{IN}) = 8 MHz, V_{CC} = 5 V Output transistors "off"			2.0	5.0	mA
	Ring oscillator operation mode, V_{CC} = 5 V Output transistors "off"			300	900	µA
	f(X_{IN}) = 8 MHz, V_{CC} = 5 V (in WIT state), functions except timer 1 disabled, Output transistors "off"			1.6	3.2	mA
	f(X_{IN}) = 2 MHz, V_{CC} = 2.4 V (in WIT state), functions except timer 1 disabled, Output transistors "off"			0.2		mA
	Ring oscillator operation mode, V_{CC} = 5V (in WIT state), functions except timer 1 disabled, Output transistors "off"			150	450	µA
	Increment when A-D conversion is executed f(X_{IN}) = 8 MHz, V_{CC} = 5 V			0.5		mA
	All oscillation stopped (in STP state) Output transistors "off"	Ta = 25 °C		0.1	1.0	µA
		Ta = 85 °C			10	µA

: Underlined part is added in this news.

Attached ② (7540 Group Data Sheet: Page 55)

A-D Converter Characteristics (General purpose)

Table 13 A-D Converter characteristics (One Time PROM version)
(Vcc = 2.7 to 5.5 V, Vss = 0 V, Ta = –20 to 85 °C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
—	Resolution				10	Bits
—	Linearity error	Vcc = 2.7 to 5.5 V Ta = 25 °C			±3	LSB
—	Differential nonlinear error	Vcc = 2.7 to 5.5 V Ta = 25 °C			±0.9	LSB
VOT	Zero transition voltage	Vcc = VREF = 5.12 V	0	5	20	mV
		Vcc = VREF = 3.072 V	0	3	15	mV
VFST	Full scale transition voltage	Vcc = VREF = 5.12 V	5105	5115	5125	mV
		Vcc = VREF = 3.072 V	3060	3069	3075	mV
tCONV	Conversion time				122	tc(XIN)
RLADDER	Ladder resistor			55		kΩ
IVREF	Reference power source input current	VREF = 5.0 V	50	150	200	μA
		VREF = 3.0 V	50	70	120	
II(AD)	A-D port input current				5.0	μA

Table 14 A-D Converter characteristics (Mask ROM version)
(Vcc = 2.7 to 5.5 V, Vss = 0 V, Ta = –20 to 85 °C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
—	Resolution				10	Bits
—	Linearity error	Vcc = 2.7 to 5.5 V Ta = 25 °C			±3	LSB
—	Differential nonlinear error	Vcc = 2.7 to 5.5 V Ta = 25 °C			±1.5	LSB
VOT	Zero transition voltage	Vcc = VREF = 5.12 V	0	15	35	mV
		Vcc = VREF = 3.072 V	0	9	21	mV
VFST	Full scale transition voltage	Vcc = VREF = 5.12 V	5105	5125	5150	mV
		Vcc = VREF = 3.072 V	3060	3075	3090	mV
tCONV	Conversion time				122	tc(XIN)
RLADDER	Ladder resistor			55		kΩ
IVREF	Reference power source input current	VREF = 5.0 V	50	150	200	μA
		VREF = 3.0 V	50	70	120	
II(AD)	A-D port input current				5.0	μA

Attached ② (7540 Group Data Sheet: Page 65)

A-D Converter Characteristics (Extended operating temperature version)

Table 26 A-D Converter characteristics (One Time PROM version)
(V_{CC} = 2.7 to 5.5 V, V_{SS} = 0 V, Ta = –40 to 85 °C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
—	Resolution				10	Bits
—	Linearity error	V_{CC} = 2.7 to 5.5 V Ta = 25 °C			±3	LSB
—	Differential nonlinear error	V_{CC} = 2.7 to 5.5 V Ta = 25 °C			±1.5	LSB
V_{OT}	Zero transition voltage	V_{CC} = V_{REF} = 5.12 V	0	15	35	mV
		V_{CC} = V_{REF} = 3.072 V	0	9	21	mV
V_{FST}	Full scale transition voltage	V_{CC} = V_{REF} = 5.12 V	5105	5125	5150	mV
		V_{CC} = V_{REF} = 3.072 V	3060	3075	3090	mV
t_{CONV}	Conversion time				122	$t_{c(XIN)}$
R_{LADDER}	Ladder resistor			55		kΩ
I_{VREF}	Reference power source input current	V_{REF} = 5.0 V	50	150	200	μA
		V_{REF} = 3.0 V	50	70	120	
$I_{I(AD)}$	A-D port input current				5.0	μA

2.Difference between general purpose version and automotive version (extended operating temperature version)

There are some difference (ex. Operating temperature range, power source voltage) between One Time PROM version and mask ROM version.

3. Note on A-D converters

•Characteristics of 7540 group A-D converter is not defined as the absolute accuracy but relative accuracy.

-The provided absolute accuracy

A-D converter characteristics (Vcc = 2.7 to 5.5 V, Vss = 0 V, Ta = –20 to 85 °C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
—	Resolution				10	Bits
—	Absolute accuracy (Quantization error excluded)				±4	LSB
tCONV	Conversion time				61	tc(XIN)
RLADDER	Ladder resistor			35		kΩ
IVREF	Reference power source input current	VREF = 5.0 V	50	150	200	µA
II(AD)	A-D port input current			0.5	5.0	µA

-The provided relative accuracy (7540 Group)

A-D converter characteristics (Vcc = 2.7 to 5.5 V, Vss = 0 V, Ta = –20 to 85 °C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
—	Resolution				10	Bits
—	Linearity error	Vcc = 2.7 to 5.5 V Ta = 25 °C			±3	LSB
—	Differential nonlinear error	Vcc = 2.7 to 5.5 V Ta = 25 °C			±0.9	LSB
VOT	Zero transition voltage	Vcc = VREF = 5.12 V	0	5	20	mV
		Vcc = VREF = 3.072 V	0	3	15	mV
VFST	Full scale transition voltage	Vcc = VREF = 5.12 V	5105	5115	5125	mV
		Vcc = VREF = 3.072 V	3060	3069	3075	mV
tCONV	Conversion time				122	tc(XIN)
RLADDER	Ladder resistor			55		kΩ
IVREF	Reference power source input current	VREF = 5.0 V	50	150	200	µA
		VREF = 3.0 V	50	70	120	
II(AD)	A-D port input current				5.0	µA

The relative accuracy is defined as the actual A-D conversion offset value based on the ideal a zero transition voltage and a full scale transition. And it is defined as a linearity error of an error associated with a line between V0T and VFST. Therefore, to consider relative accuracy in stead of an absolute accuracy, need to add the linearity error value to the offset value of V0T and VFST.
The definition of the A-D conversion accuracy in the 7540 Group is explained below (refer to attached ③).

Attached ③

(1) Definition of A-D conversion accuracy

The A-D conversion accuracy is defined below.

●Relative accuracy

① Zero transition voltage (V_{OT})
This means an analog input voltage when the actual A-D conversion output data changes from "0" to "1."

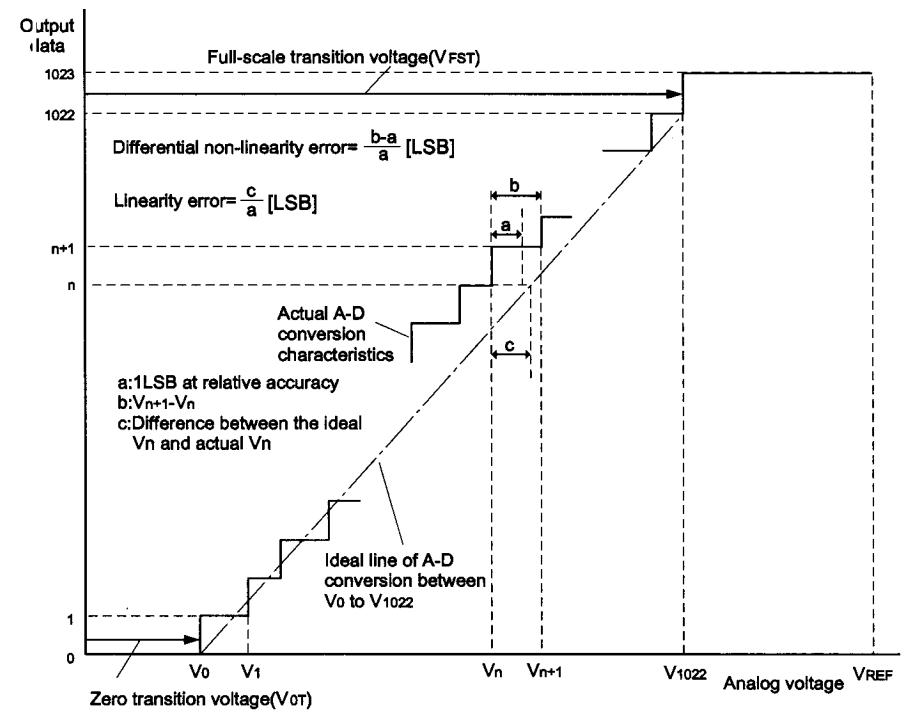
② Full-scale transition voltage (V_{FST})
This means an analog input voltage when the actual A-D conversion output data changes from "1023" to "1022."

③ Linearity error
This means a deviation from the line between V_{OT} and V_{FST} of a converted value between V_{OT} and V_{FST}.

④ Differential non-linearity error
This means a deviation from the input potential difference required to change a converted value between V_{OT} and V_{FST} by 1 LSB of the 1 LSB at the relative accuracy.

●Absolute accuracy

This means a deviation from the ideal characteristics between 0 to V_{REF} of actual A-D conversion characteristics.



Definition of A-D conversion accuracy

Vn: Analog input voltage when the output data changes from "n" to "n + 1" (n = 0 to 1022)

- 1 LSB at relative accuracy → $\frac{V_{FST} - V_{OT}}{1022}$ (V)
- 1 LSB at absolute accuracy → $\frac{V_{REF}}{1024}$ (V)

4.Note on 7540 Group Timer Y, Timer Z

1. Note
When Timer Y or Timer Z count operation is restarted after it is stopped, the setting values of the corresponding prescaler and primary are not reloaded correctly to the counter. Accordingly, the count value is undefined.

2. Countermeasure
When Timer Y or Timer Z count operation is restarted after it is stopped, set each value as shown below first, and then, restart the count operation.

Countermeasure by software for timer Y (timer Z)

↓

TYZM bit 3 (bit 7) ← 1zzz — Timer Y (Timer Z) count operation stop

↓

PREY (PREZ) ← Setting value — Timer Y (Timer Z) prescaler re-setting
TYP, TYS (TZP, TZS) ← Setting value (Note) — Timer Y (Timer Z) primay, secondary re-setting

↓

TYZM bit 3 (bit 7) ← 0zzz — Timer Y (Timer Z) count restart

Note: When the timer mode and programmable one-shot generation mode (only for timer Z) is selected, re-setting to the secondary latch is not required since the secondary latch is not used.

In the Mask ROM version of the 7540 Group, the above value is reloaded correctly to the counter. Accordingly, this countermeasure by software is not required for the Mask ROM version. And the software which this countermearure is applied can be used on Mask ROM version.

3. Revision schedule for One Time PROM version and Emulator MCU version
ES version of the products changed by hardware logic will be released as following schedule.

- One Time PROM version (M37540E8GP, M37540E8FP, M37540E8SP): 1Q, 2002.
- Emulator MCU (M37540RSS): 4Q, 2001.
  (Revision schedule changed)

5.Note on 7540 Group Switch of clock

Please use the following procedure, if using these operations.
- Selection of clock division ratio
- Oscillation control of ring oscillator
- Oscillation control of XIN

1. Switch from XIN (double-speed mode) to ring oscillator

```
LDM # 1 1 0 0 0 0 0 02, CPUM : Ring oscillator oscillation is enabled.
                               : Oscillation stabilizing wait time is not needed when starting ring oscillation.
LDM # 1 0 0 0 0 0 0 02, CPUM : Clock division ratio is selected. (Clock is supplied from ring oscillator.)
NOP                            : When switching from the double-speed mode, insert three NOP instructions.
NOP
NOP
LDM # 1 0 0 1 0 0 0 02, CPUM : XIN oscillation is stopped.
```

2. Switch from XIN (high-speed mode) to ring oscillator

```
LDM # 0 0 0 0 0 0 0 02, CPUM : Ring oscillator oscillation is enabled.
                               : Oscillation stabilizing wait time is not needed when starting ring oscillation.
LDM # 1 0 0 0 0 0 0 02, CPUM : Clock division ratio is selected. (Clock is supplied from ring oscillator.)
NOP                            : When switching from the high-speed mode, insert one NOP instruction.
LDM # 1 0 0 1 0 0 0 02, CPUM : XIN oscillation is stopped.
```

3. Switch from XIN (middle-speed mode) to ring oscillator

```
LDM # 0 1 0 0 0 0 0 02, CPUM : Ring oscillator oscillation is enabled.
                               : Oscillation stabilizing wait time is not needed when starting ring oscillation.
LDM # 1 0 0 0 0 0 0 02, CPUM : Clock division ratio is selected. (Clock is supplied from ring oscillator.)
                               : When switching from the middle-speed mode, NOP instruction is not required.
LDM # 1 0 0 1 0 0 0 02, CPUM : XIN oscillation is stopped.
```

4. Switch from ring oscillator to XIN oscillation

```
LDM # 1 0 0 0 0 0 0 02, CPUM : Ceramic or RC oscillation is enabled.
NOP                            : Oscillation stabilizing wait time (When using ceramic oscillation, please
                                 inquire stabilization time of oscillation makers.)
NOP
LDM # X X 0 0 0 0 0 02, CPUM : Clock division ratio is selected. (switch to XIN clock)
                               : When switching from the ring oscillator, NOP instruction is not required.
LDM # X X 0 0 1 0 0 02, CPUM : Ring oscillator is stopped.
```