CONFIDENTIAL

ZUD-CE-11-0059

RL78/I1A Product Information

For Lighting and Power Supply

Renesas Electronics

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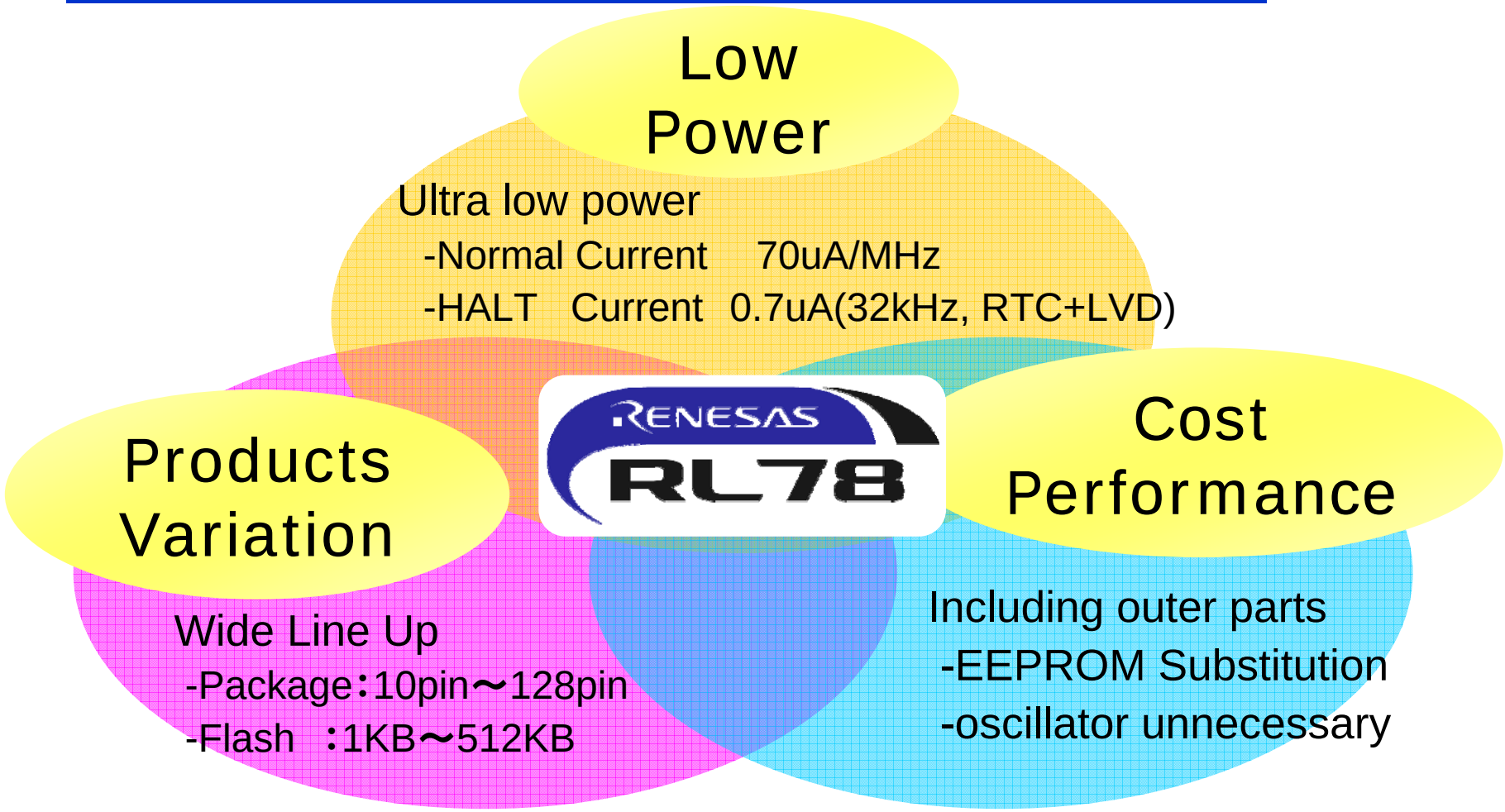
RL78family Concept

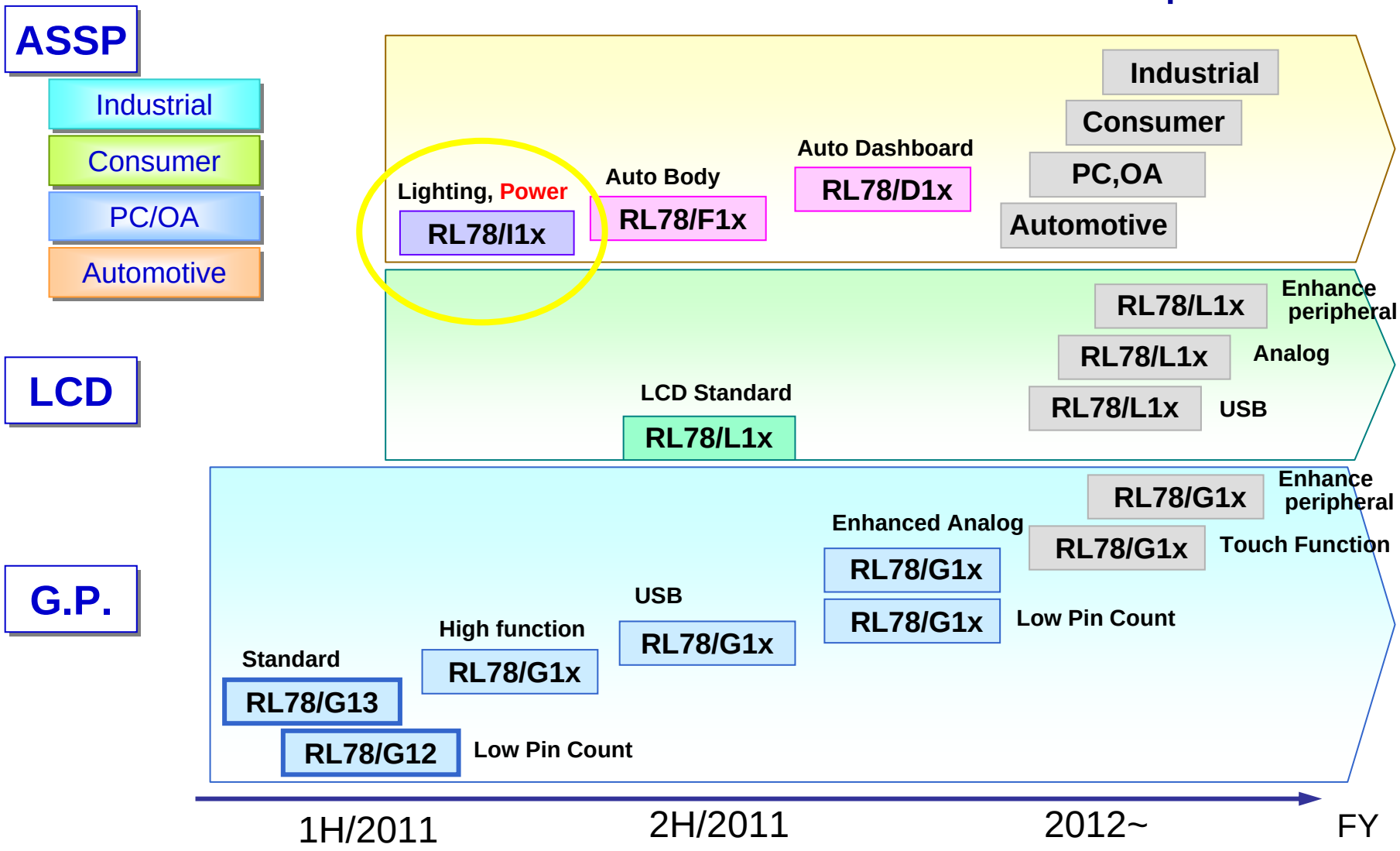
Aim for WW No.1 of three Items

Low Power No.1　Variation No.1　Cost PerformanceNo.1



RL78 Roadmap

RL78/I1A is the first ASSP of RL78 new core platform



Positioning of RL78/I1A

RL78/I1A comes with Special functions dedicated to lighting and power supply market in the latest technology platform

Lighting & Power Supply

16～32pin

78K0 / Ix2

LED lighting
Fluorescent lighting

- High resolution PWM (40MHz)
- Single PFC control
- Analog function (CMP w/ 5bitDA. AMP, PGA)
- Protection

Under Development

20～38pin

RL78/I1A

LED lighting
Power Supply

- High resolution PWM (64MHz)
- Dithering function (64MHz x 16)
- Max frequency setting
- Interleave PFC control
- Analog function (CMP w/ 8bitDA, PGA)
- Instruction performance (16bit core, MAC, DMA)
- Enhanced Protection

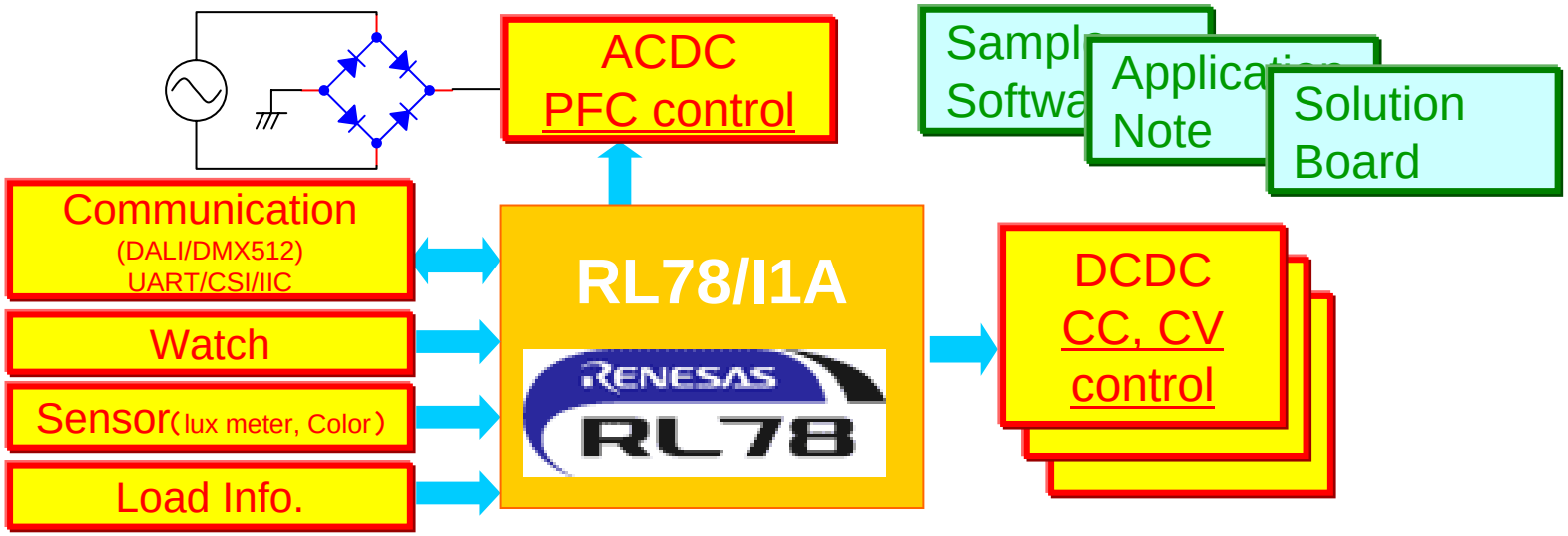
G.P

78K0/Kx2, -L

10～128pin

RL78/G1x

RL78/I1A Concept



Low Cost

- Realize PFC control, Constant Voltage, Constant Current control with one chip

Value added application

- Intelligent best fit dimming control by Communication, Time management, sensor inputs

Easy

- Many sample software, application note, solution board to be prepared

Platform expansion

- 20pin to 38pin with 32/64KB Flash fitting the lighting, power supply market

Product Information

RL78/I1A Features

1. Featuring basic functions for lighting and power supply application

- LED control, PFC control timer
  - 64MHz source clock, Zero current detection, output shut down in emergency
- Analog functions for Feedback
  - - 10bitADC(2.125usec), AMP（PGA）, Comparators
- 125 deg C high temperature

2. Enhanced connectivity functions

- UART, IIC, CSI.　　DALI, DMX512 for lighting control

3. Featuring special functions for Intelligent and efficiency control

- Dithering(1nsec average resolution)、Soft-start
  Max frequency setting, Interleave PFC, Standby waiting for communication

4. Variety of solutions prepared for quick starting evolution (Ix2 case)

- DC-DC LED lighting board, PFC LED lighting board,
  Communication master board, DCDC power supply board etc.
- Sample software and GUI software automatic generation tool

Main target applications

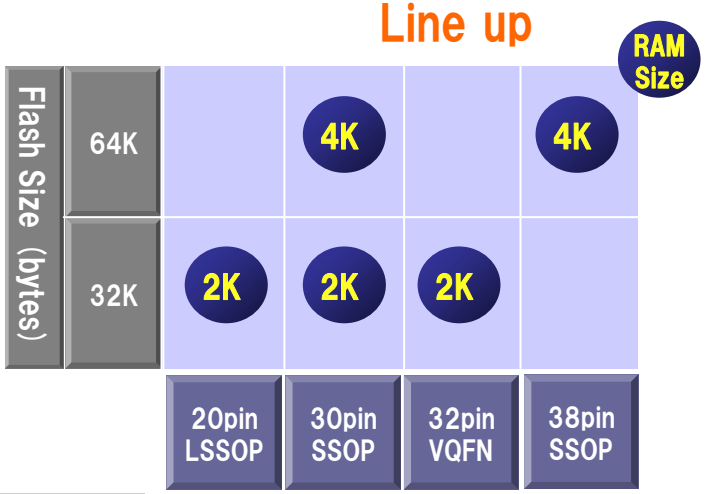
■ Lighting	:	LED lighting, OLED lighting, Florescent lighting etc.
■Power supply	:	TV power supply, other general DC-DC, AC-DC

RL78/I1A Outline

Feature

- 16bit CPU＋MAC Performance improvement
- Internal OSC（CPU MAX 32MHz）
- 16bit PWM Timer 2output x 3ch
- Real･Time･Counter
- Serial IF（UART, I2C, CSI, DMX）
- Operation temperature up to 125℃

Line up



RL78/I1A

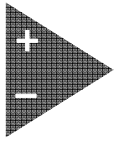
Lighting & Power ContTimer

- Count Clock Max 64MHz
- PWM High resolution by dithering
- Stop LED over current by Soft Start
- Burst Control by PWM Gating function
- Digital･Interleave PFC control function
- Hi-Z Output expanding with Comparator

Analog function

- Timer synchronousA/D(Max11ch)
- Comparator 6ch
- Window comparator function
- PGA Amp

  Fixed magnification mode
（4/8/16/32 times）

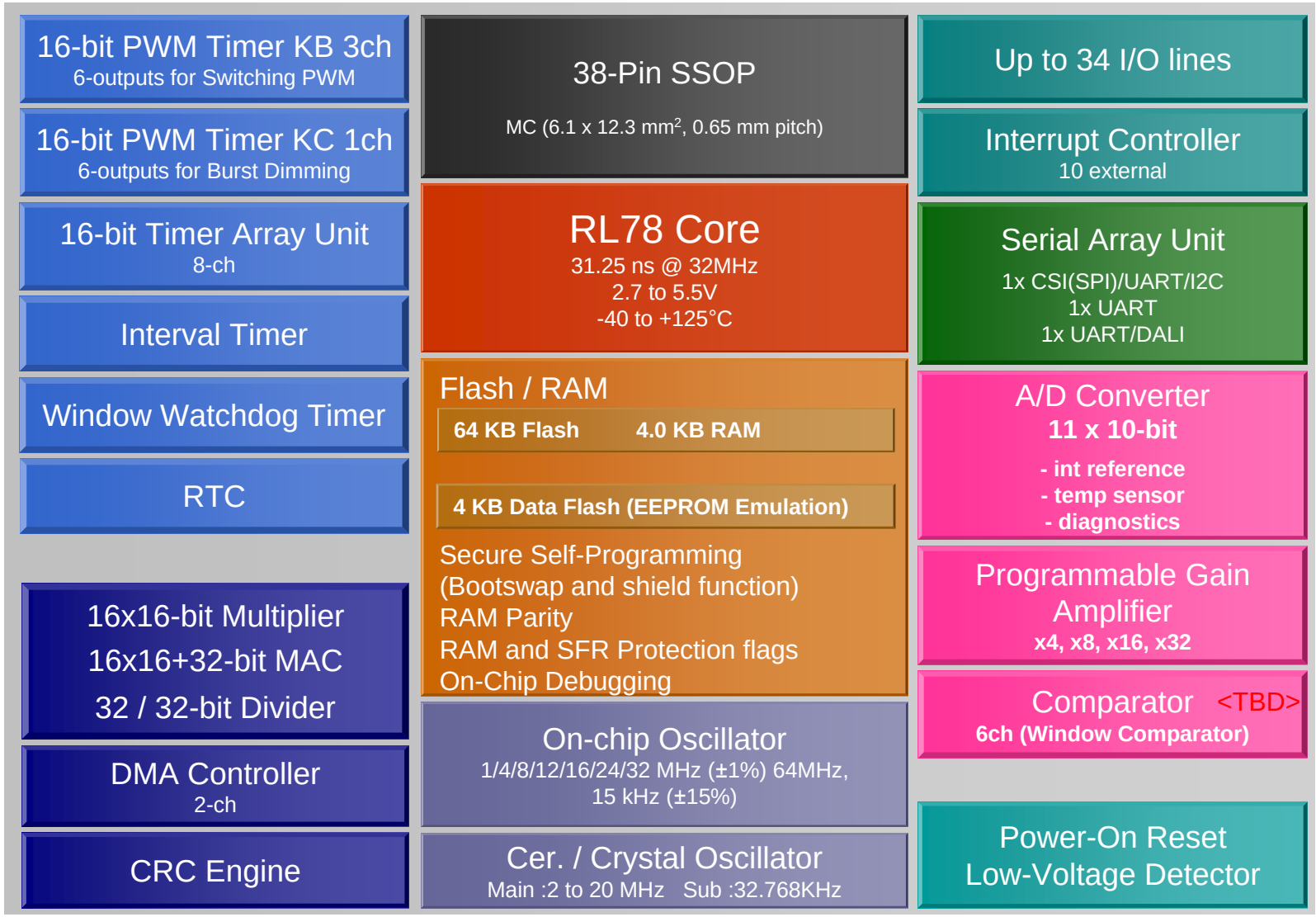


注意：製品開発中のため、変更する場合がございます。
RENESAS

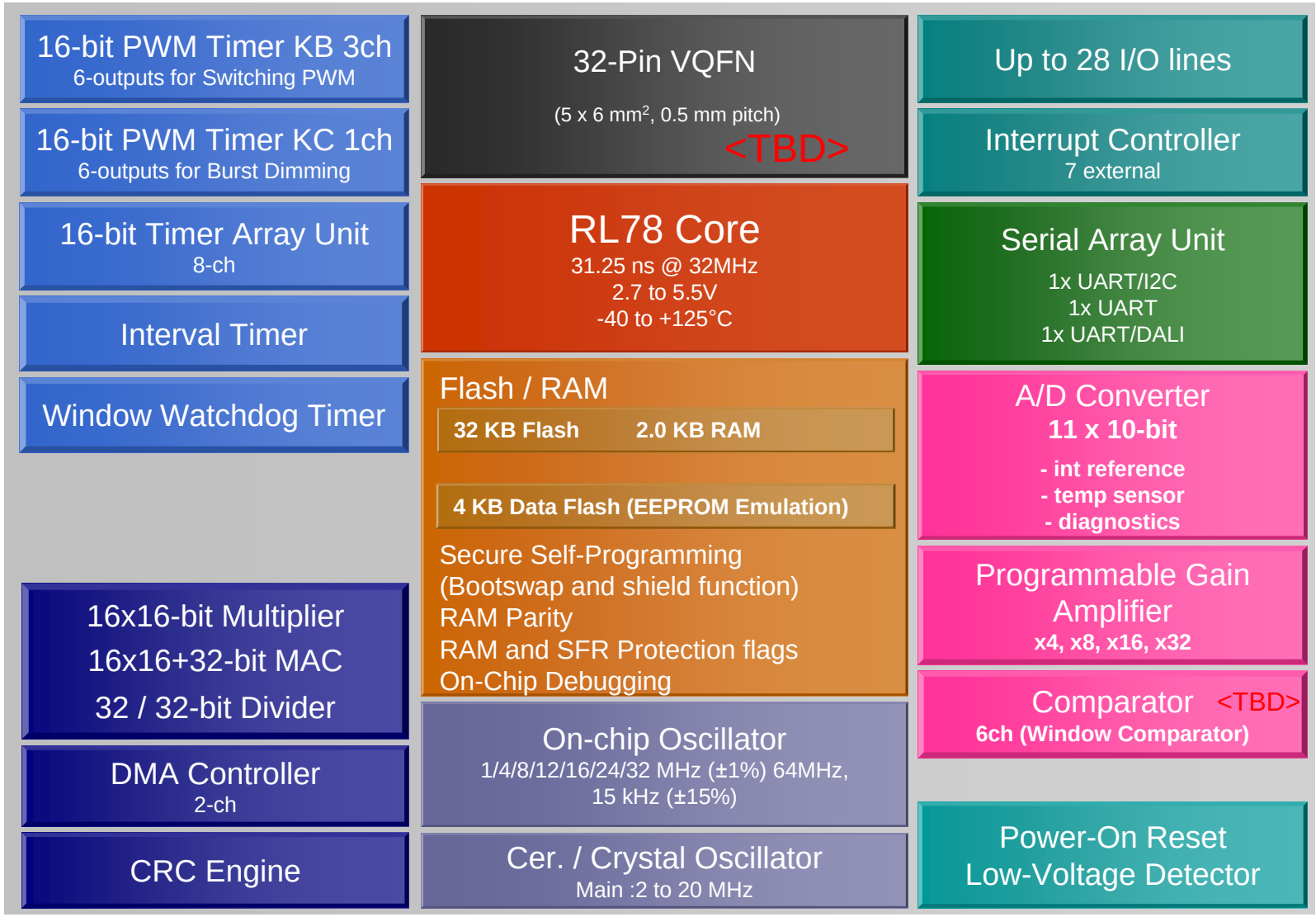
RL78/I1A Function list(20 - 38 pin)

Nick name		RL78/I1A			
Pin		20-pin	30-pin	32-pin	38-pin
Memory	Flash ROM	32KB	32KB、64KB	32KB	64KB
	Data Flash	4KB	4KB	4KB	4KB
	RAM	2KB	2KB、4KB	2KB	4KB
CPU		RL78 CPU Core			
Operating Frequency		32MHz (max.) internal clock, 20MHz (max.) external clock, Timer KB : 64MHz			
Oscillation Circuit	Crystal / Ceramic	1MHz～20MHz			1MHz～20MHz, 32.768kHz
	Internal OSC	32MHz +/- 1% (Target, 2.7V～5.5V) ,15kHz±15% (Target, 2.7V～5.5V)			
I/O		16	26	28	34
Timer	16bit Timer KB	2ch(4 outputs)	3ch(6 outputs)		
	16bit Timer KC	1ch(3 outputs)	1ch(6 outputs)		
	16bit Timer TAU	16bit Timer x 6ch、 “16bit Timer x1ch/8bit Timer x 2ch” x 2ch			
	12bit Timer	Interval timer 1ch (15kHz/32.768kHz*) *38pin			
Real time counter		-			1
10bit A/D converter (Scan, 4ch, AD result comp, function)		6ch	11ch	11ch	11ch
Comparator		4	6	6	6
PGA		1ch (x 4,8,16,32) 6ch input selectable			
Serial Interface	CSI/UART (DALI) /I2C	-/1 (1) /1	-/1 (1) /1	-/1 (1) /1	1/1 (1) /1
	UART (DALI)	-	2 (1)	2 (1)	2 (1)
External Interrupt		4	7	7	10
Other peripherals		MAC / DIV (16*16,32/32,16*16+32) for PI calculation, DMA x 2ch, LVI, POC			
Safety functions		WDT, TRAP instruction, Flash memory CRC calculation, RAM parity error detection, Illegal memory access detection, Frequency detection, RAM guard, SFR guard			

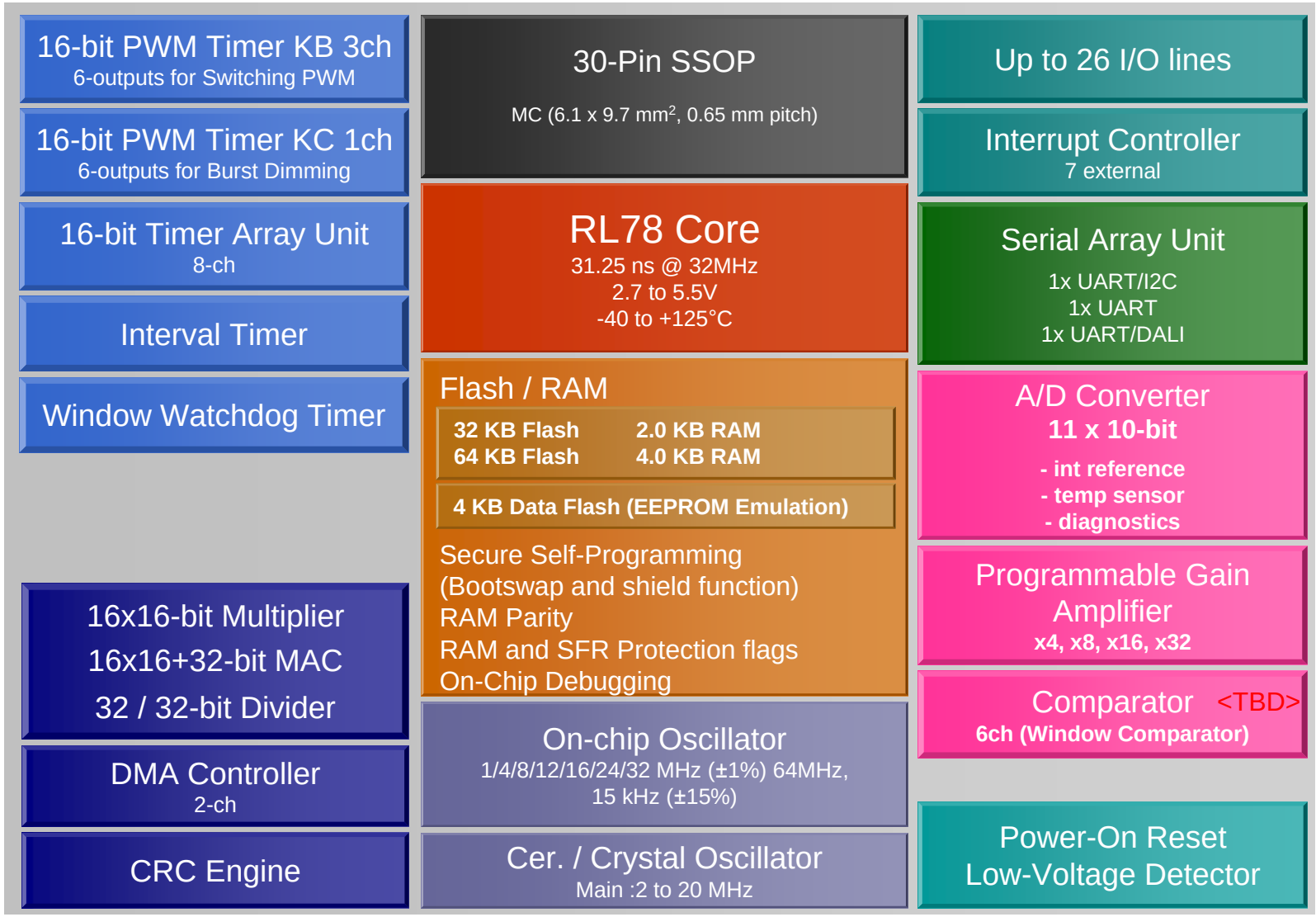
Block Diagram - 38pin



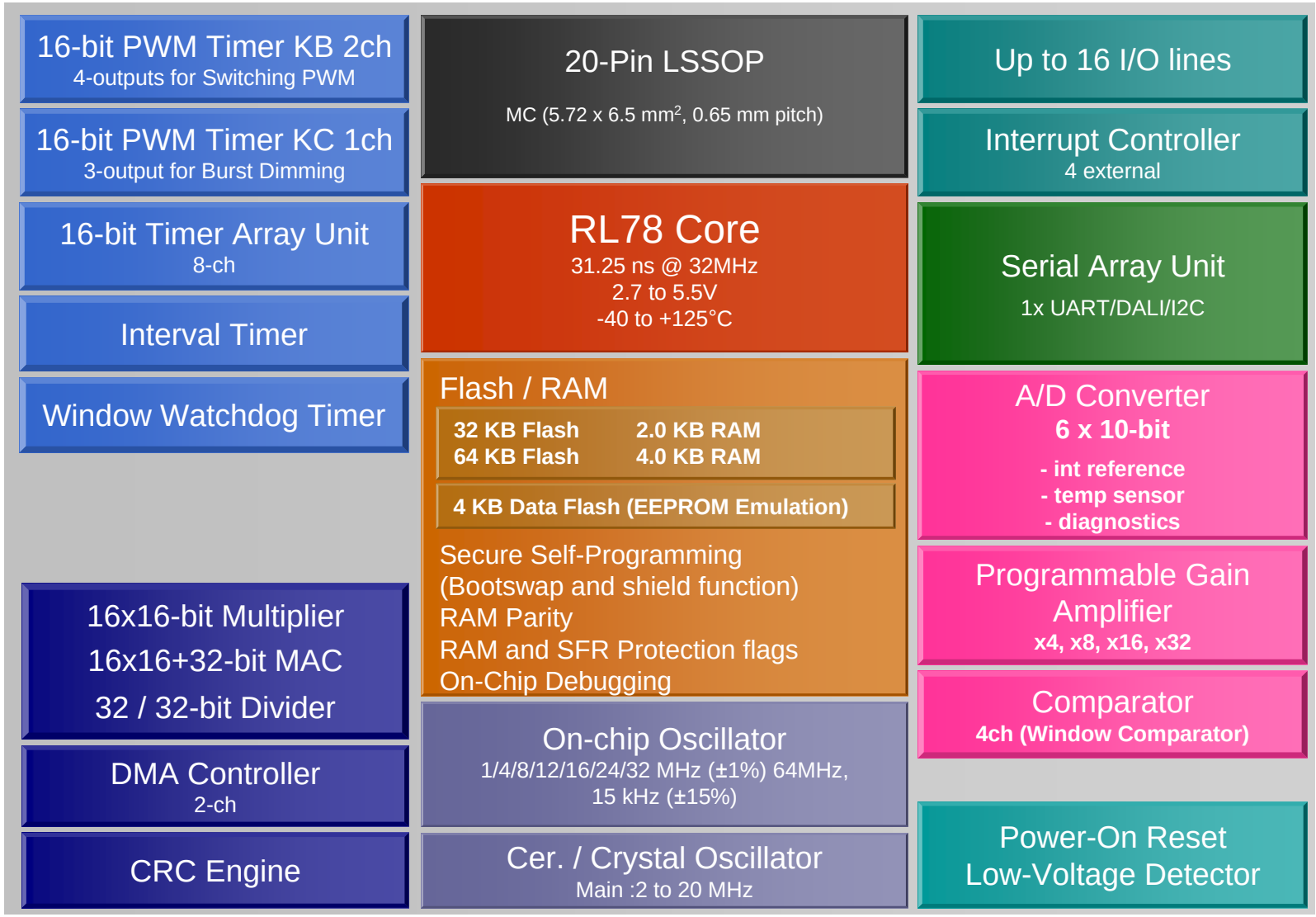
Block Diagram - 32pin



Block Diagram - 30pin



Block Diagram - 20pin



RL78/I1A & 78K0/Ix2 comparison

		RL78/I1A*	78K0/Ix2
CPUコア		RL78（16bit）	K0（8bit）
Flash/RAM		Flash: 64K, RAM: 4K (MAX)	Flash: 16K, RAM: 768K （MAX）
System Clock		・Int. OSC. 32MHz±1% (Target) ・Timer Clock: 64MHz ・CPU Clock : 32MHz	・Int. OSC. 4MHz±2% or 8MHz ・Timer Clock : 40MHz ・CPU Clock : 20MHz
WDT Clock		・Low speed int. OSC. 15kHz	・Low speed int. OSC. 30kHz
Timer	High performance PWM output	・16bit TMKB (2output) x 3ch ・High resolution PWM (64MHz) Dithering :High resolution mode (64Mhz x 16) ・Interleave PFC control ・Output shutdown function enhanced ・Soft start	・16bit TMX (2output) x 2ch ・High resolution PWM (40MHz) ・Single PFC control ・Output shutdown function
	PWM gating	・16bit TMKC 1ch （TMKB 6ch separate gating）	・8bit TMH:1ch（TMX 4ch the same gating）
	Base timer	・16bit Timer 8ch	・16bit TM0:1ch, 8bit TM5:1ch
	WDT、RTC	・1ch(15kHz)、RTC*	・1ch(30kHz)
Serial I/F		・UART(DALI enhanced)/IIC:1ch, 3wireCSI:1ch	・UART(DALI)/IIC:1ch, 3wireCSI:1ch
10bit A/D		・11ch (max.)	・9ch (max.)
OP-AMP		・1ch (PGA mode) 6ch input selectable	・1ch (PGA mode, Single mode)
Comparator		・6ch, window comparator ・REF: VDD/AVREF with 8bitDA or CMPCOM pin	・3ch ・REF: 1.6V Int. ref with 5bitDA or CMPCOM pin
MUL/Calculation		・16bit x 16bit + 32bit (2clock)	・8bit x 8bit, 16bit x 16bit
Others		・DMA 2ch, Data Flash 4KB, Safety functions, Thermo	
Temperature/VDD		Ta=-40 - +125℃, 2.7V - 5.5V	Ta=-40 - +105℃, 2.7V - 5.5V

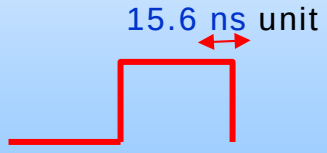
*38pin only

Differences in blue

Merit of Renesas RL78/I1A (1/3)

High performance PWM output timer

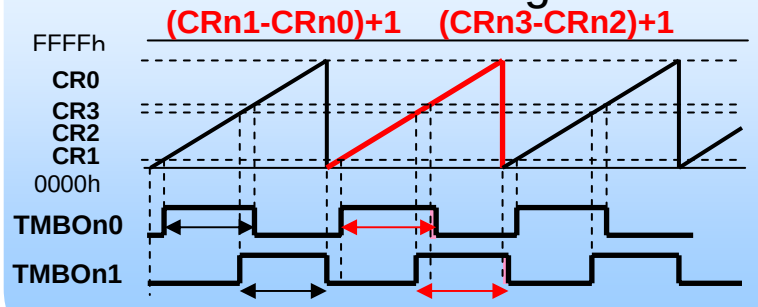
- 64MHz source (Intl OSC. + PLL)
- Duty & Frequency change in operation



So fine dimming / voltage control

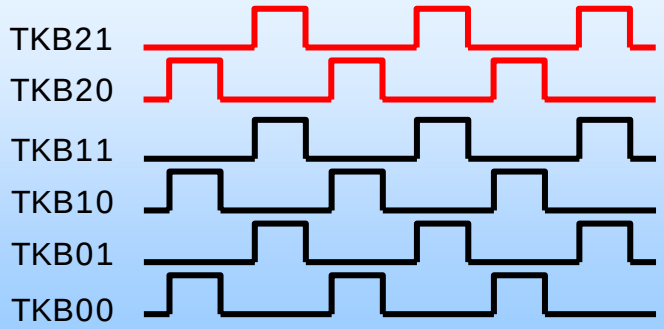
Dithering function

- Min 0.97ns average resolution



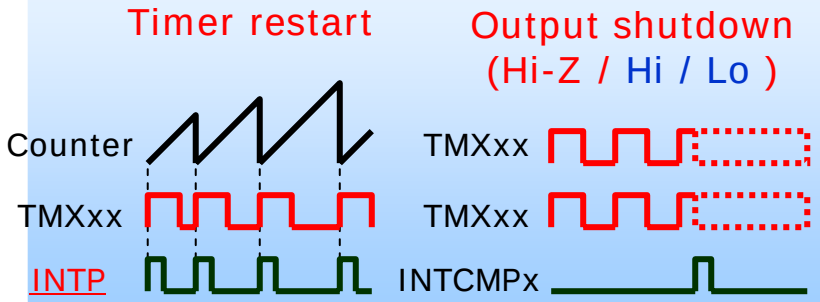
So fine dimming / voltage control

16 bit timer KB 2ch/4ch/6ch synchronize



LED constant current sync. control

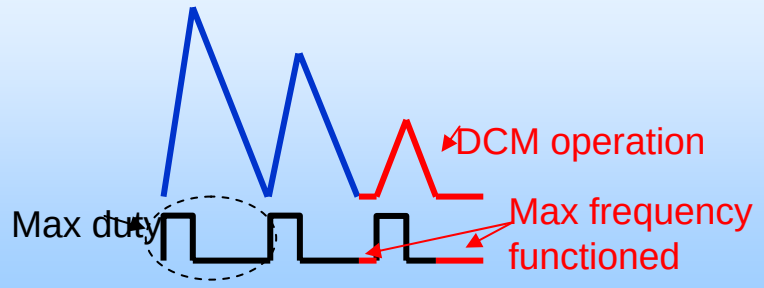
16 bit timer KB INTP/Comparator interlocking



PFC control *OV/OC Protection*

Merit of Renesas RL78/I1A (2/3)

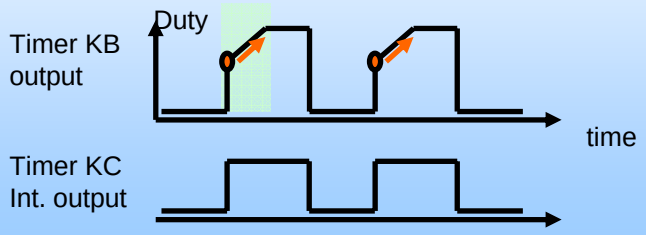
16 bit timer KB Max frequency setting



Noise elimination and efficiency

Soft start

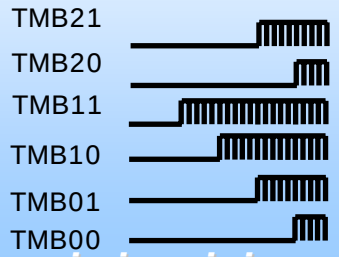
- Auto duty-increment in variable cycle



Cut inrush current in switching

Timer KB separate gating

- Separate gating by Timer KC



LED color mix in minimum CPU load

DALI communication Slave function

- Manchester method
- Rx: 19、20、27bit
  Tx:11、19、27bit (Slave)

Lighting communication hardware

Merit of Renesas RL78/I1A (3/3)

Just 0.22uA enables waiting for communication

【Power consumption comparison】

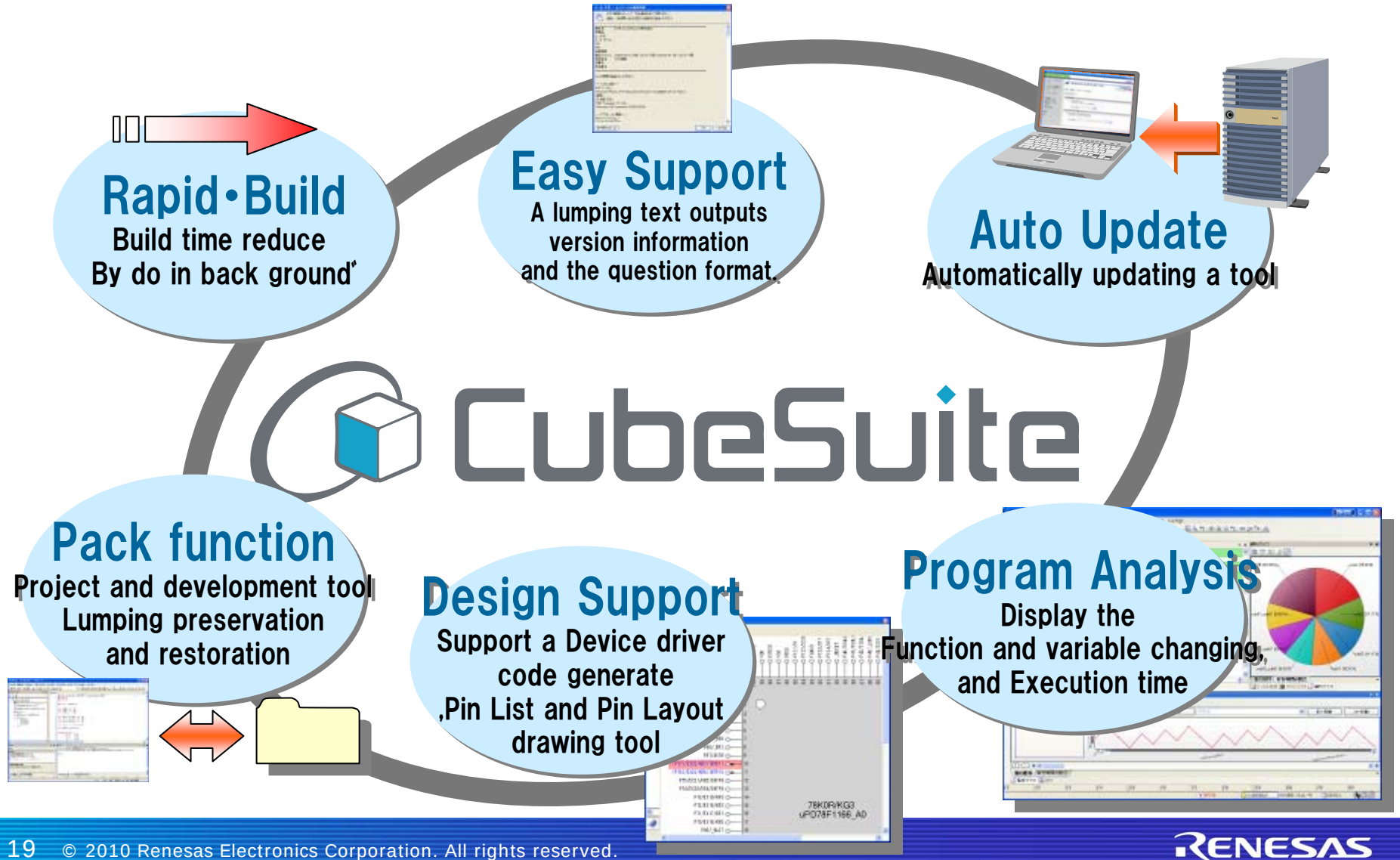
	RL78/I1A	78K0/Ix2
Main Run	3.6mA (Target) CPU clock 16MHz TMKB clock 64MHz PLL-ON LED / Power] controlling	4.5mA CPU Clock 20MHz TMX Clock 40MHz PLL-ON LED / Power controlling
Main Halt	1.0mA (Target) CPU clock 16MHz TMKB clock 64MHz PLL-ON	1.3mA CPU Clock 20MHz TMX Clock 40MHz PLL-ON UART(DALI) waiting
STOP	0.22uA (Target) UART(DALI) waiting	0.3uA

Values are typ. These values are target and does not guarantee the final specification
Not including peripheral functions.

Tool introduction

CubeSuite

The integrated development environment which is the all-in-one which makes the software development comfortable



Tool for RL78 Family

Rich Tools which corresponds to all development phase prepared

Software dev. ▶▶▶ Debugging ▶▶▶ Writing

Software dev.

CubeSuite

Coding/
Build/
Device・Driver

CubeSuite

Integrated development environment

OS

Itron based

Real time OS

Debugging

Debug
by Pc

CubeSuite

Simulator

Debug
by basic function

E1

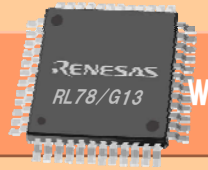
On Chip emulator
with programming function

Debug
by high function

IECUBE

In-circuit・emulator

Writing



Writ by
programming
service

Written in

Renesaselectronics
programming・service

Direct writing
by PC

E1

On chip ・debug・emulator
With programming function

Direct writing
by no PC

PG-FP5

Flash・memory・programmer

Plenty of power supply reference available (1x2 case)

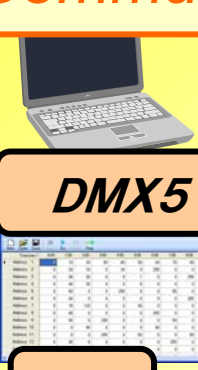
Communicatio

EZ-0008

DALI

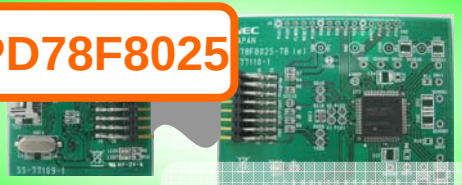
DMX512

PLC



EZ-0009

uPD78F8025



Integrated

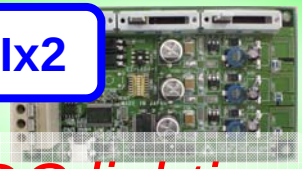
Application Note

Fluorescent Ballast control

LED lighting control

EZ-0005

78K0/Ix2

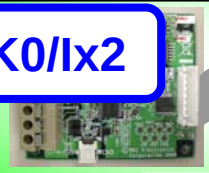


DC-DC lighting

LED lighting power supply

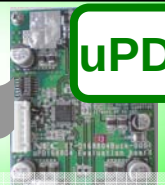
EZ-0006

78K0/Ix2



EZ-0007

uPD168804

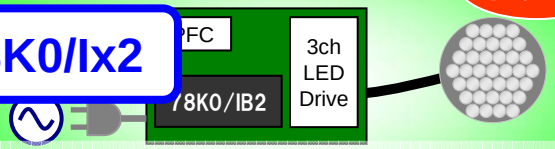


High resolution

EZ-PFCLED-001

開発中

78K0/Ix2



AC-DC(PFC) LED lighting

EZ-BLST-003

78K0/Ix2

AC-DC(PFC) lighting

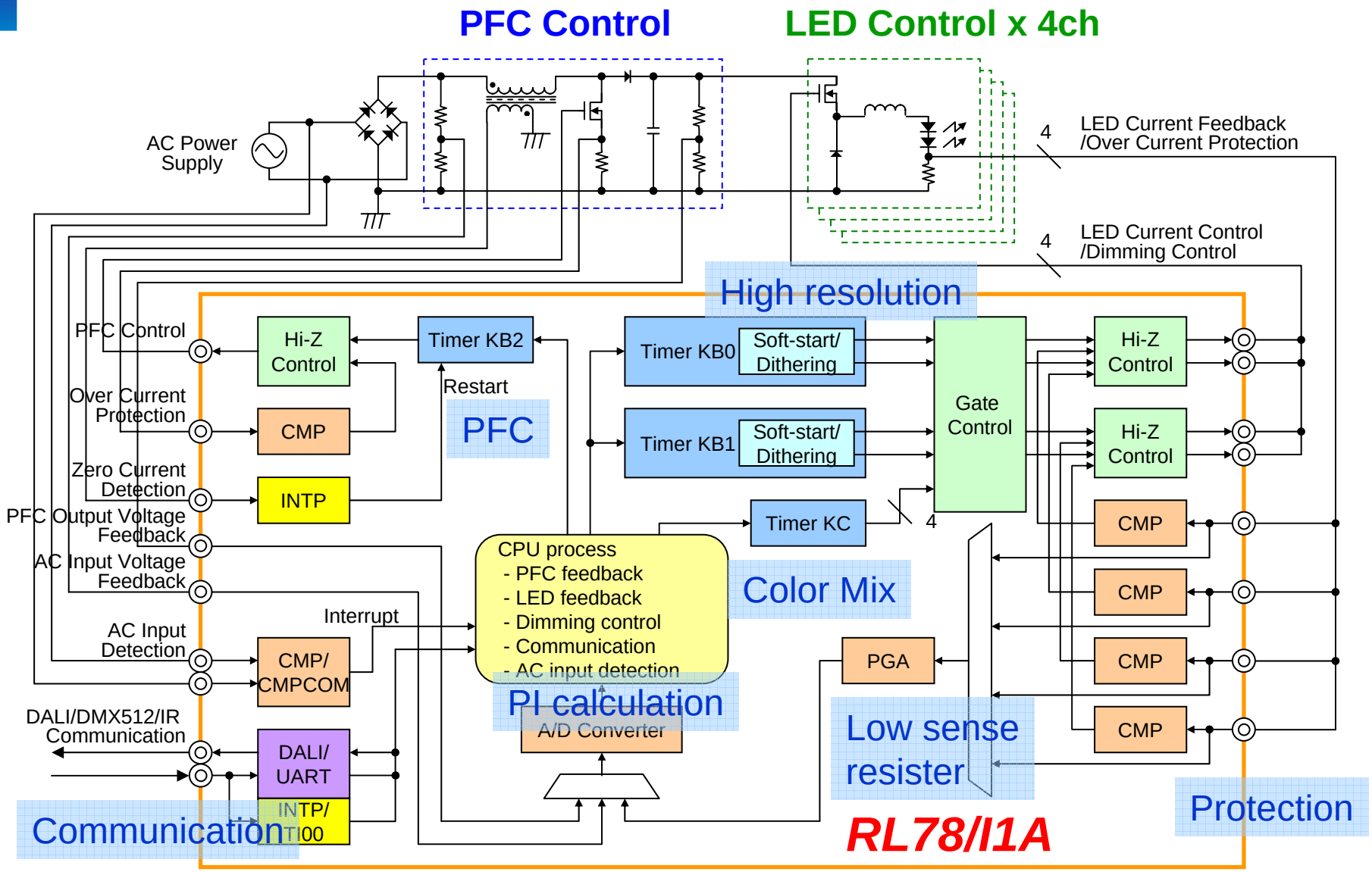
Inverter fluorescent lighting power supply

Applilet EZ for HCD

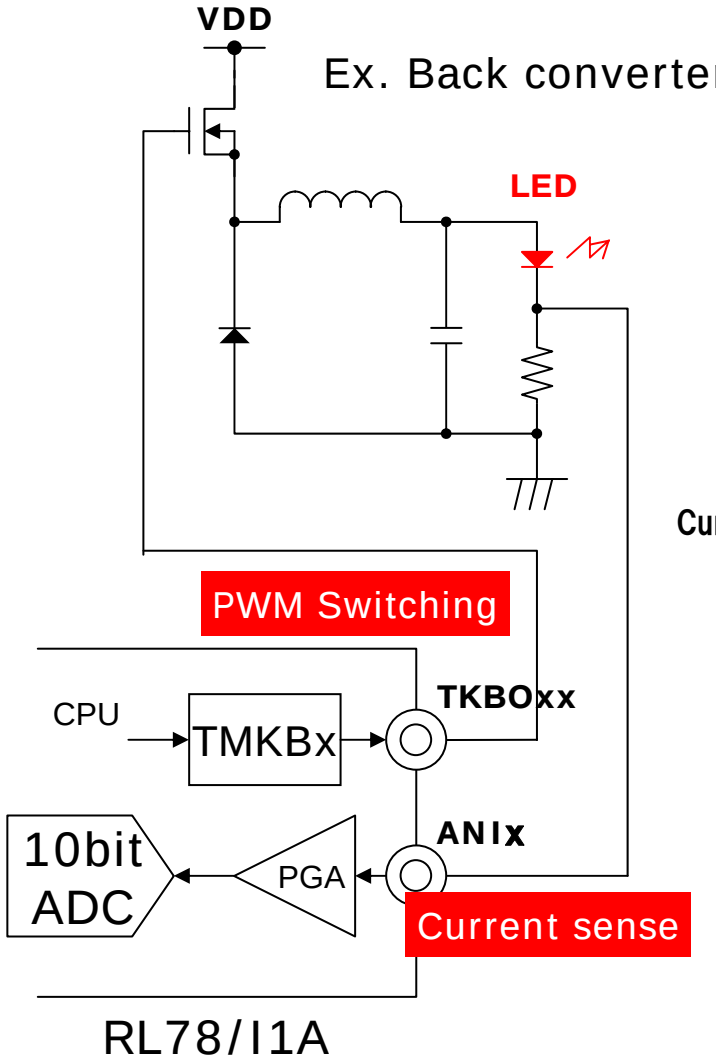
Automatic software generation tool

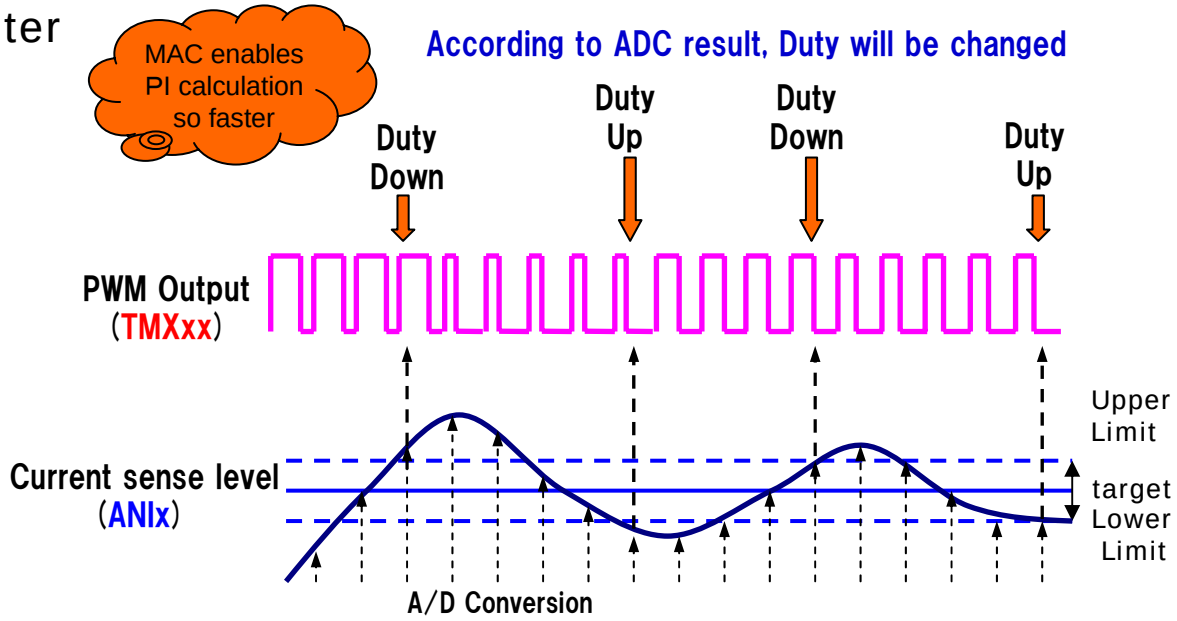
Detail technical info

System example –PFC + LED 4ch control-



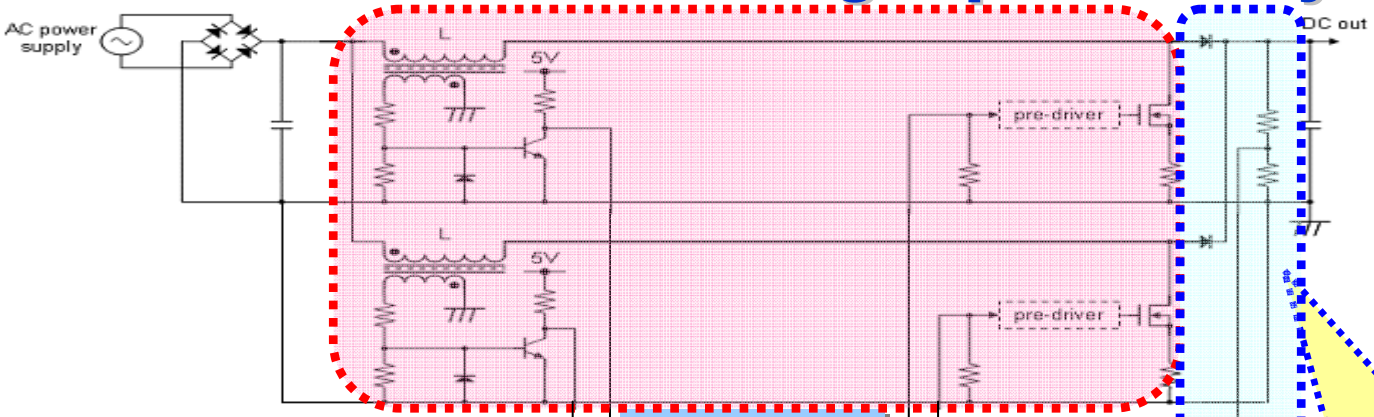
Constant current control





- Realize constant current control by changing the PWM output duty in accordance with LED current detection by A/D Converter and
- PGA in front of A/D converter allows low sense resister. This leads the system to high efficiency

PFC Interleave for high power system

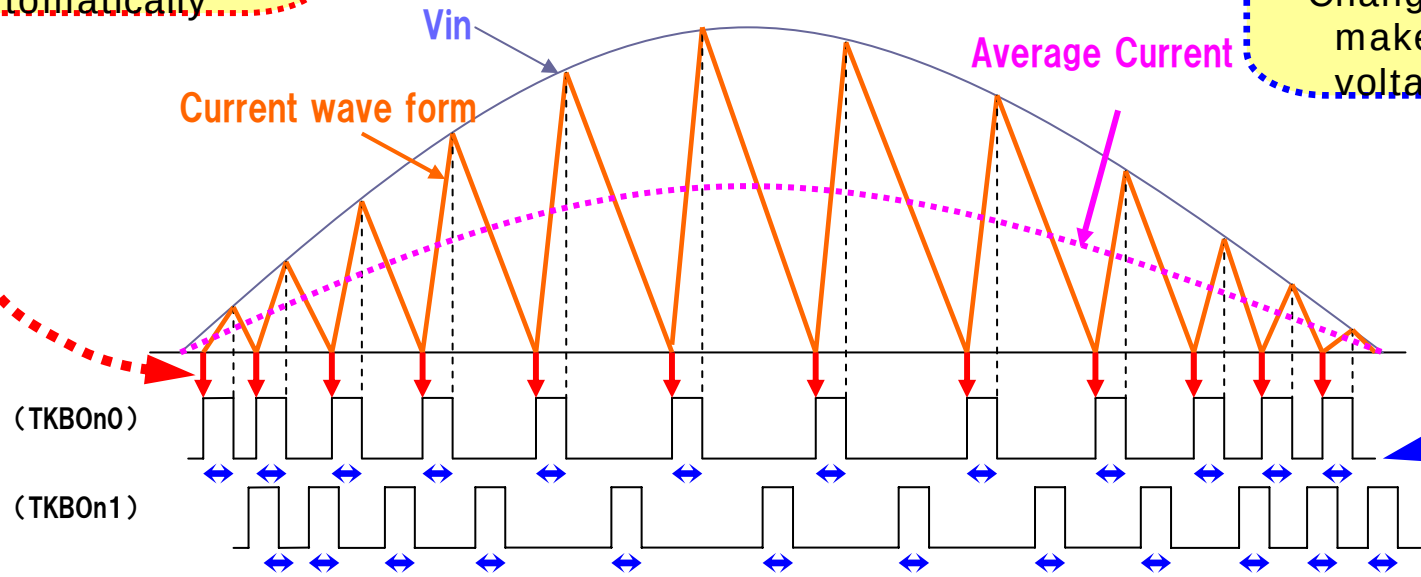


INTPx TKBOn0
INTPy TKBOn1
ADC

RL78/I1A

PFC control
By detecting Zero current with INTP, Timer restarts automatically

Boost converter
Monitoring output voltage and Change the duty to make the output voltage constant

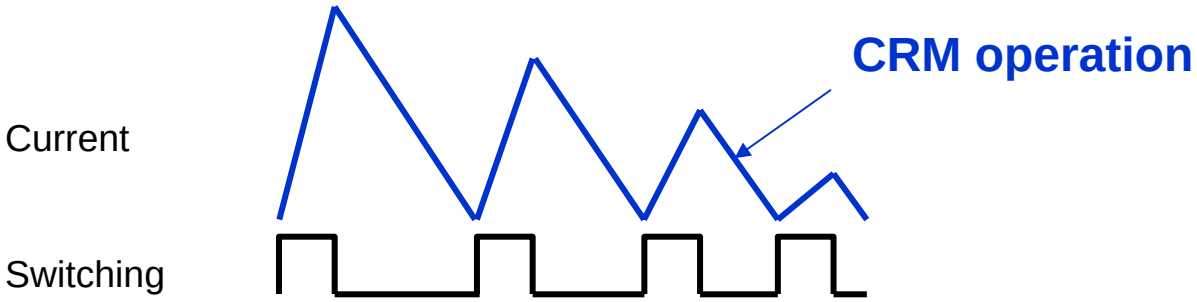


2 line control

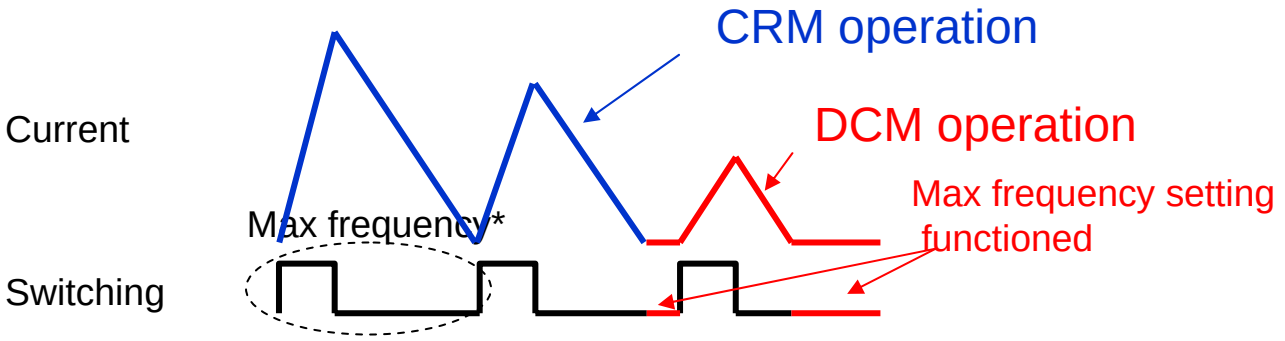
Max frequency setting function

Eliminate noise and more efficient

Max frequency setting :OFF



Max frequency setting :ON

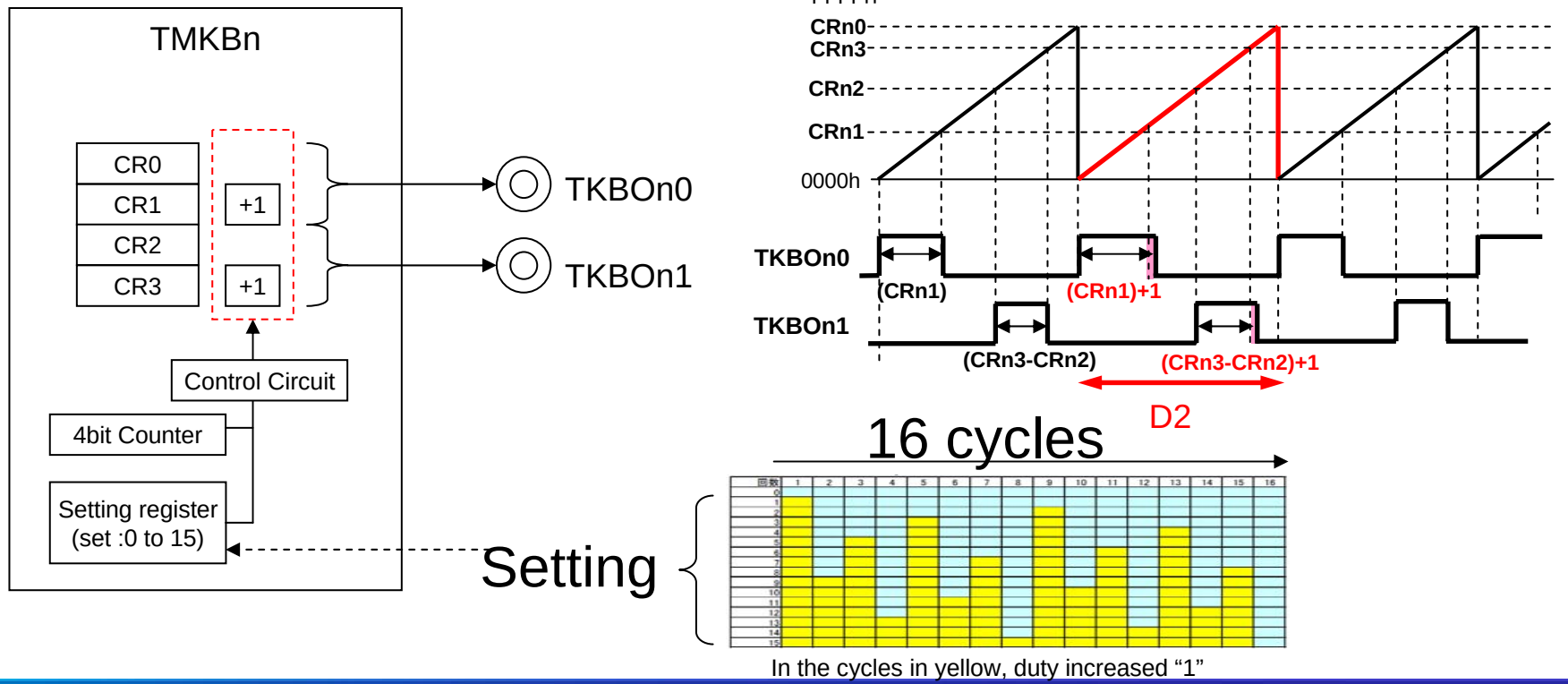


* Set by CRxx

16 bit timer High resolution (Dithering)

In N cycles (N=0-15) of 16, duty increased +1 enables x16 resolution averagely

64MHz clock　:Minimum step = 15.6ns
→w/ Dithering　:Minimum step = 15.6ns/16 = 0.97ns

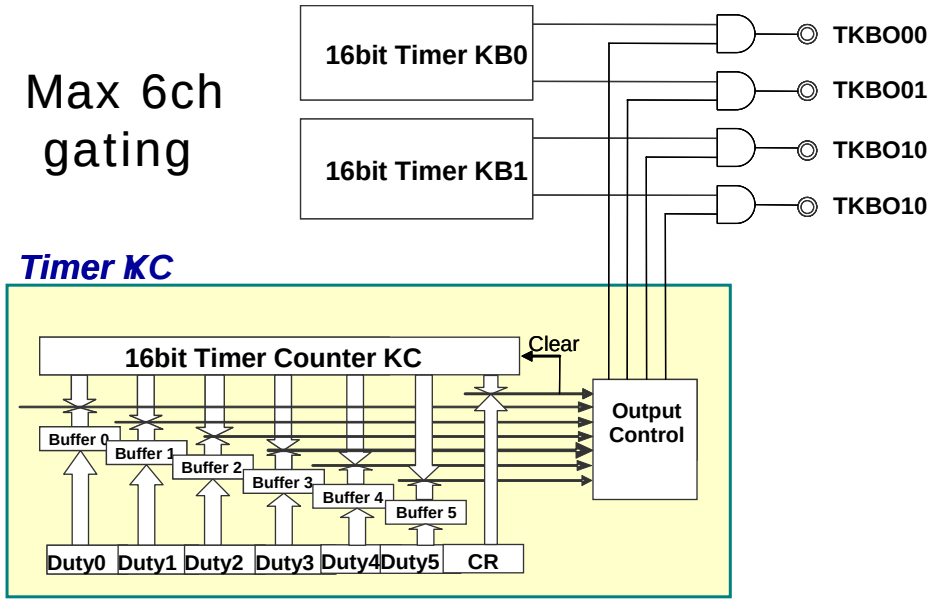


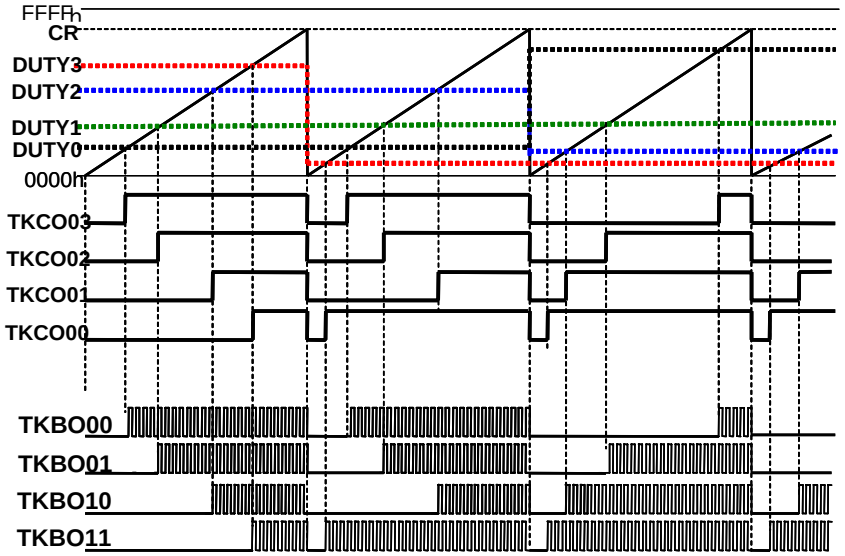
In the cycles in yellow, duty increased “1”

16 bit timer KC gating 6ch separately

Timer KC enables gating Timer KB output
LED dimming by each ch in min CPU load

Max 6ch gating

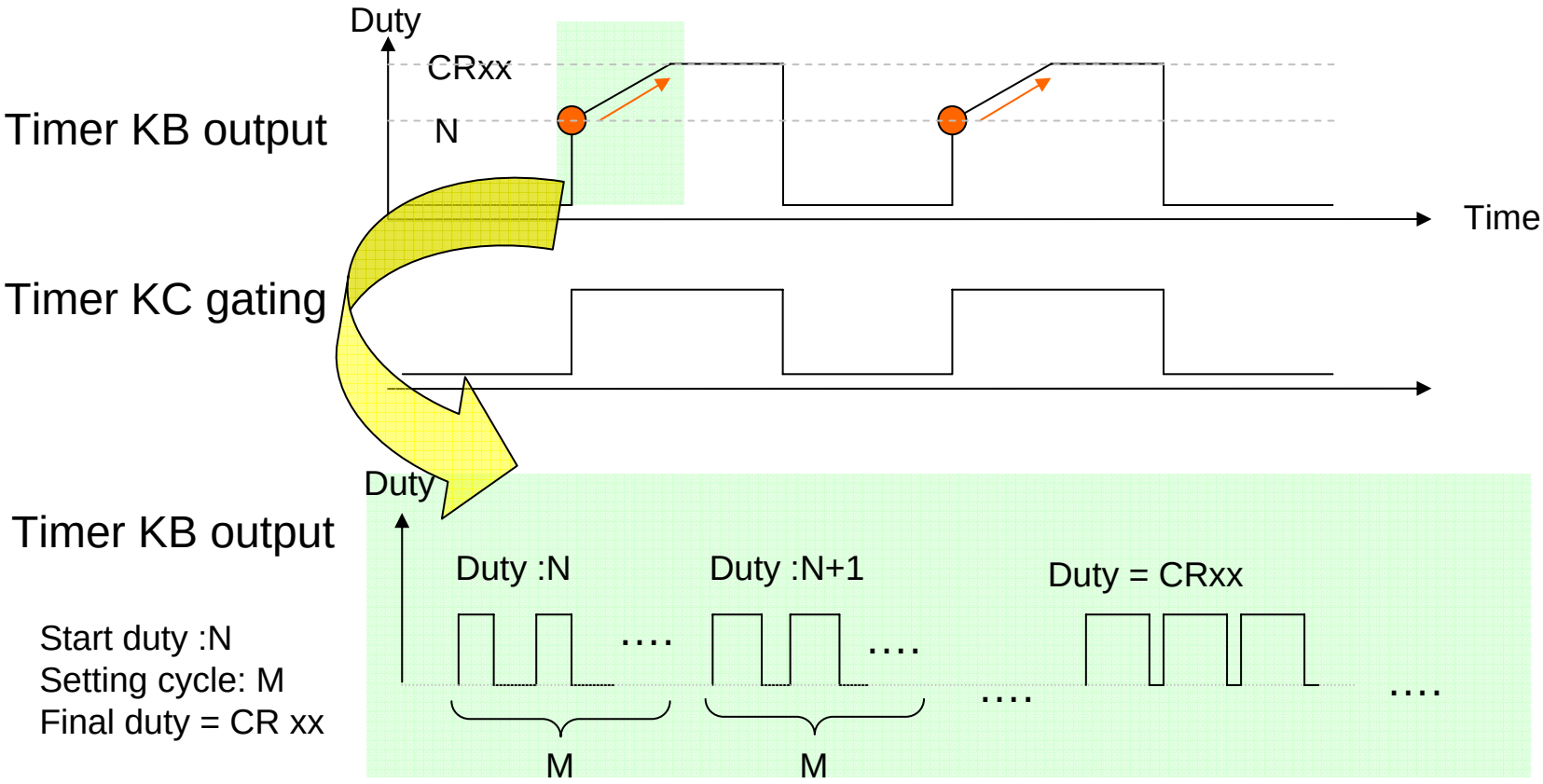




4ch出力の例

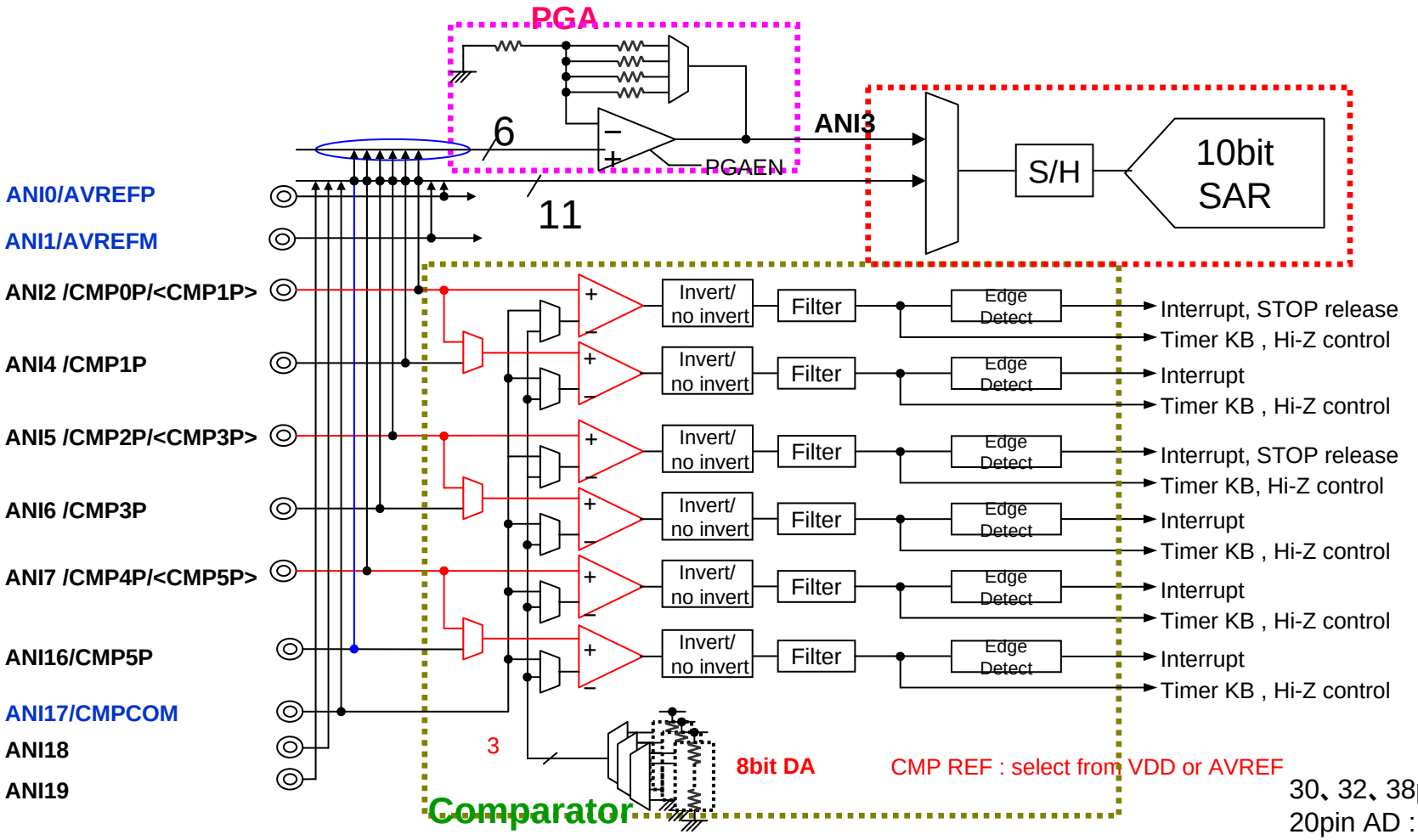
Softstart

Automatic duty-increment in setting cycle
Remove inrush current in switching timing



Integrated PGA, Comparator and ADC

PGA enables max 6ch feedback w/ small sense resister
ADC/CMP in common port can detect OCP/OVP



30、32、38pin case
20pin AD : 6ch

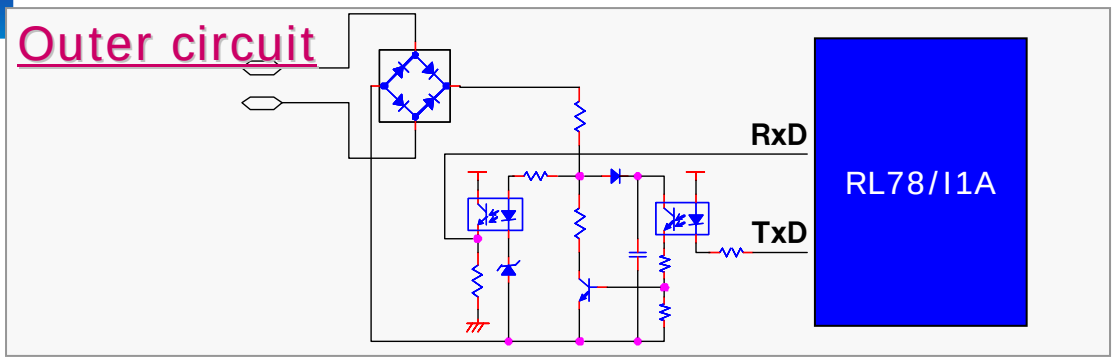
Communication protocols

Achieved the Communications for Illumination control

Protocols	RL78/I1A function		Necessary outside parts
	Use interface	Feature	
DMX512	UART	Easy detection of Break field	RS-485 Transceiver IC
DALI	UART (DALI mode)	Corresponds to Manchester Forward frame : 19,20,27bit Backward frame: 11,19,27bit Possible to receive in STOP state	Isolation I／F (Photo coupler)
IR remote Cont	Timer Array Unit	Easy to measure time in an edge intervals	Infrared receiving module
Wireless Communication	UART, 3-wire CSI (depend on RFIC)		RF receive IC
Narrow band PLC	UART, 3-wire CSI (depend on PLC IC)		PLC communicate IC

DALI Communication

Outer circuit



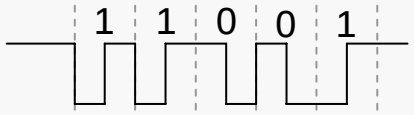
1 Slave set to 1 addressing only

MAX.16 group address
MAX.64 short address

1,200bps

Data Structure

Bit define:Use a Manchester



【Forward frame】
Master → Slave(all 19,20,27bits)

a	b	c	d	e	f

a:Start bit ("1")
b-d:Address・byte(Set to frame sending address)
e:Data・byte(Set to command)
f:Stop・bits(2bit High level)

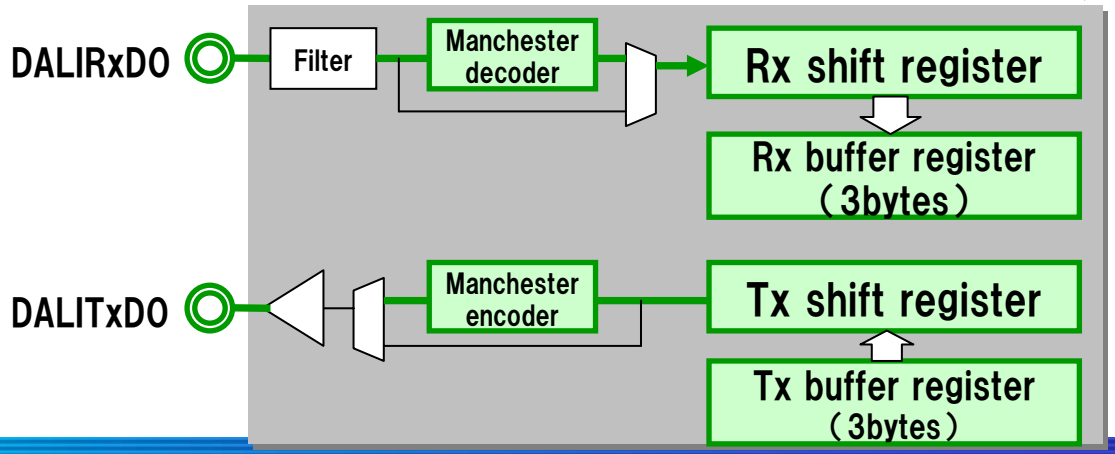
【Backward frame】
Slave →master(all11,19,27bits)

a	b	c

a:Start bit("1")
b:Data byte (Reply to master)
c:Stop/bits(2byte high level)

RL78/I1A spec.

Slave mode support in UART
(Manchester・Encode/Decode circuit equipped)

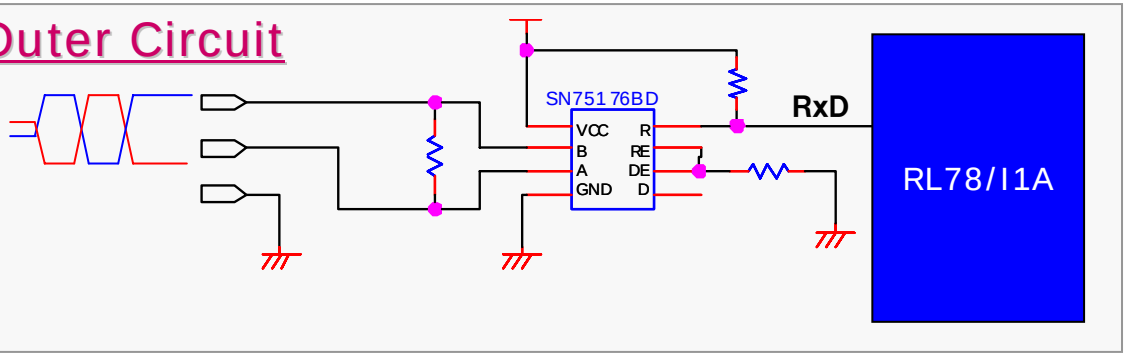


Received Forward Frame(2-3bytes)
⇒Decoded data is stocked
If detect a stop bits, Interrupt occurs

Send Backward frame(1-3byte)
⇒Automatically encode to Manchester code
If a transmit is completed, Interrupt occurs

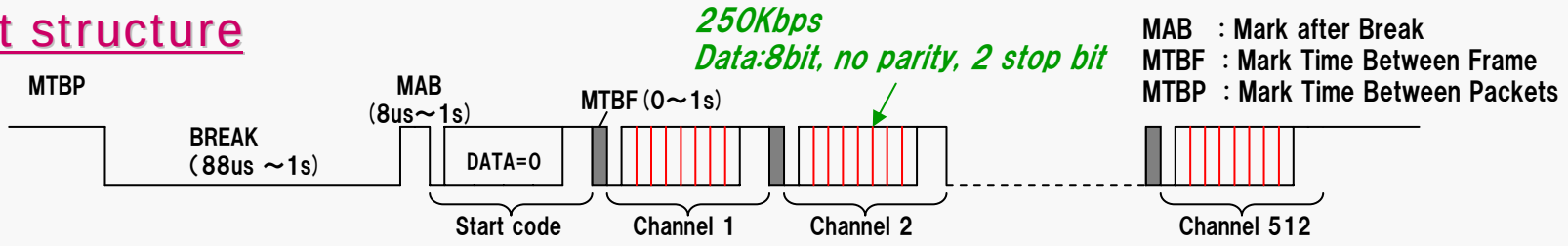
DMX512 Communication

Outer Circuit



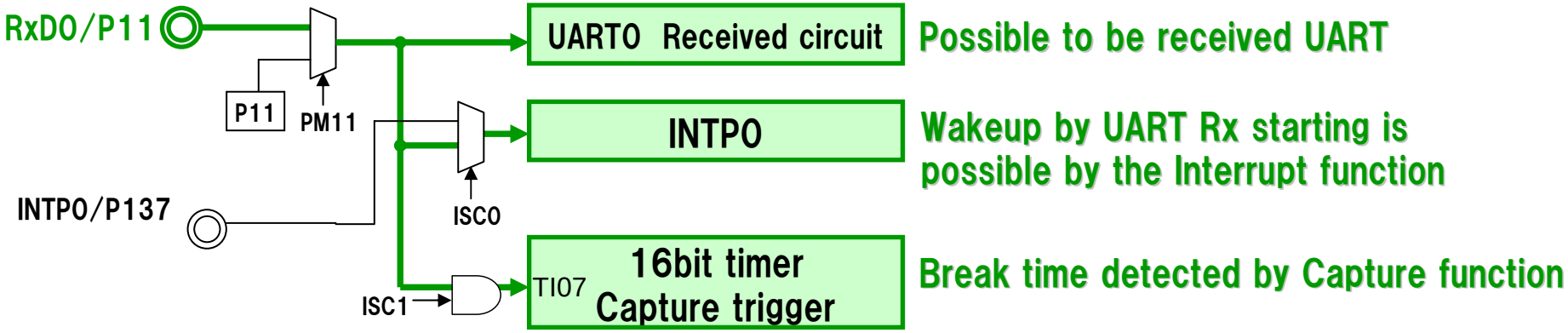
1 Slave set to more than 1 address
Ex.) Set a Each RGB Address
⇒Color-Mix be possible

Packet structure



RL78/I1A spec.

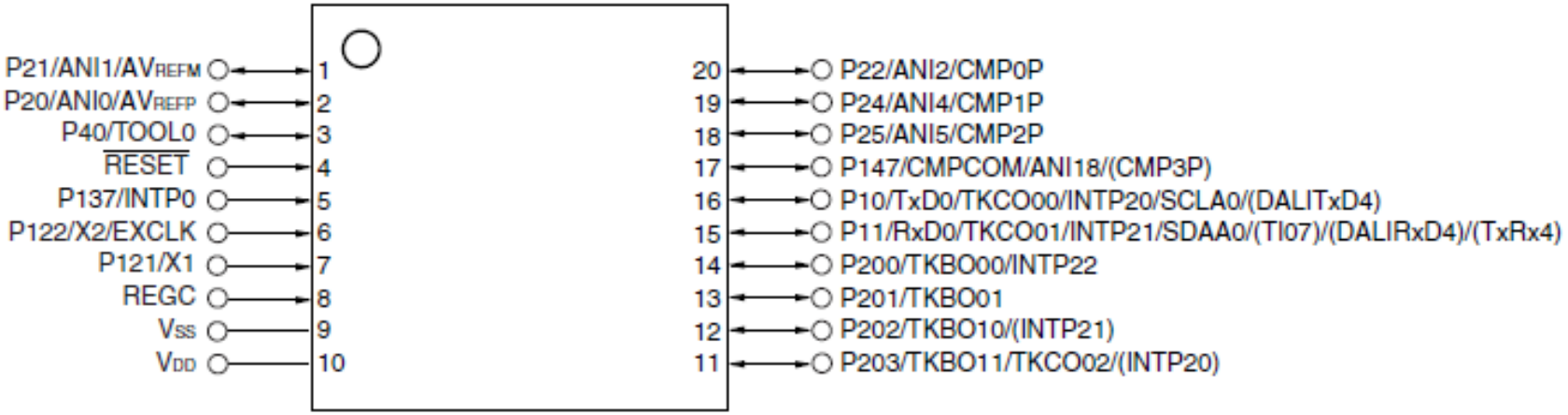
UART Rx pins can be connect Interrupt and timer



Pin Configuration

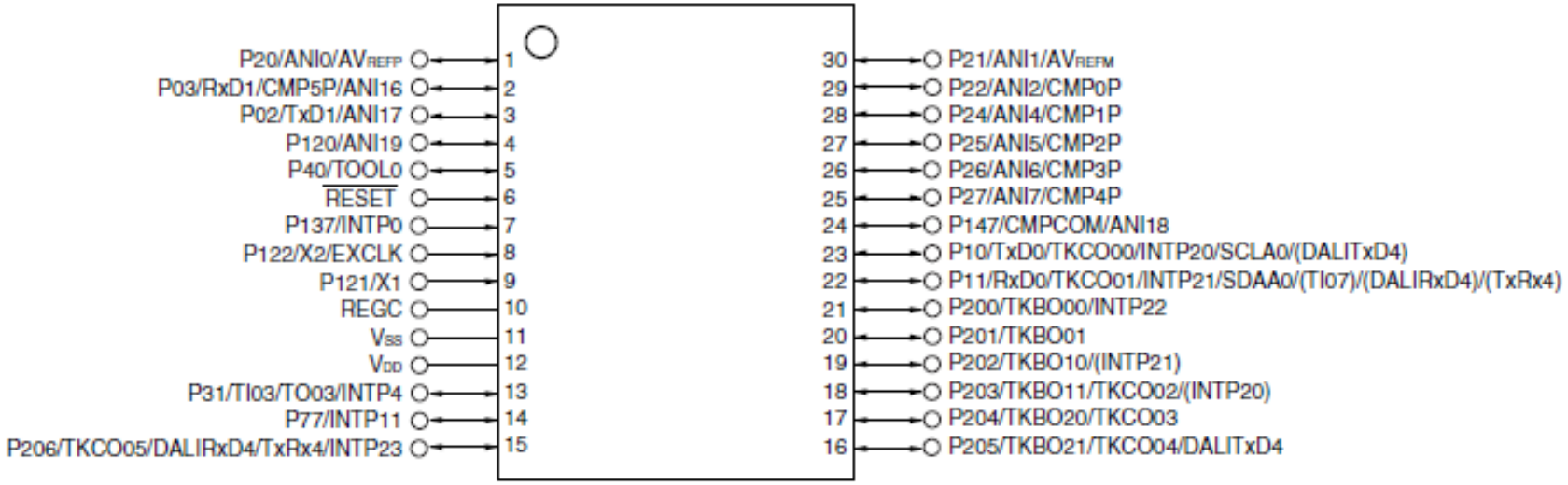
20pin plastic LSSOP 5.72mm(225mil)

Pin pitch: 0.65mm



30pin plastic SSOP 7.62mm(300mil)

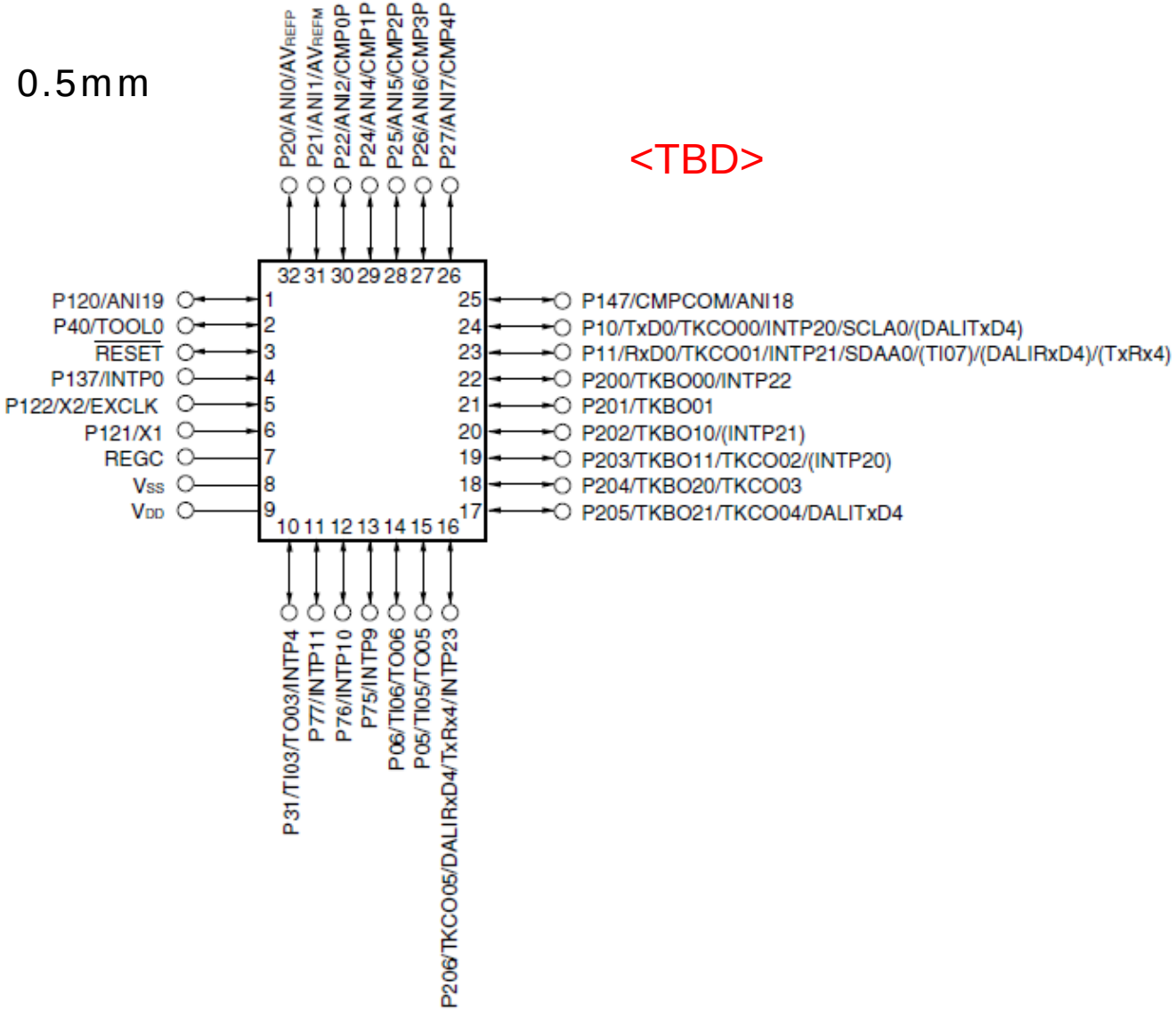
Pin pitch: 0.65mm



32pin plastic VQFN 5x6mm

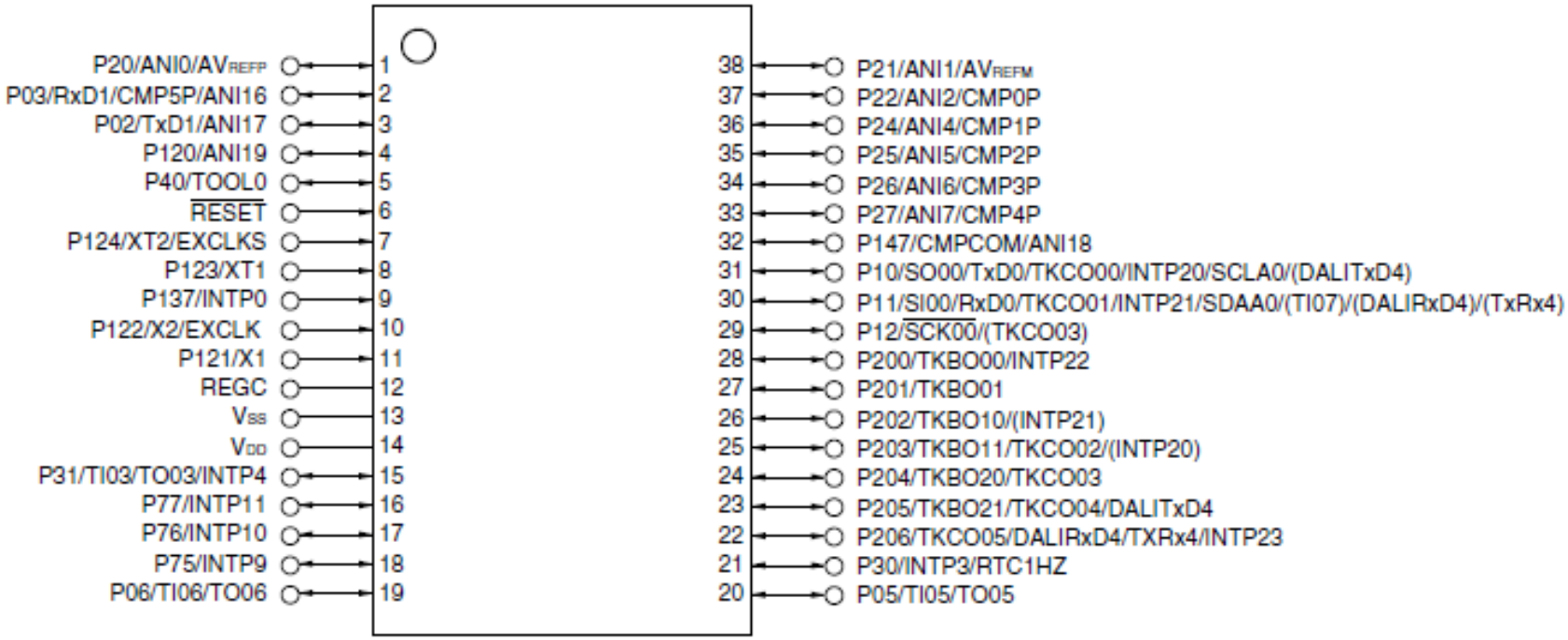
Pin pitch: 0.5mm

<TBD>



38pin plastic SSOP 7.62mm(300mil)

Pin pitch: 0.65mm



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