Ranjit Deshpande
Vice President of Engineering
Renesas Electronics America
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RENESAS ELECTRONICS AMERICA
Interview with Ranjit Deshpande - Vice President of Engineering

Featured Products

The Highs and Lows of Resistance Measurements: Can You Trust Your Test? Pt. 1
BY JONATHAN TUCKER WITH KEITHLEY INSTRUMENTS
How characterizing resistances lower than 10 ohms or higher can be significantly more complex than it seems and how this process can be simplified.

What’s In a Name?
BY DAVE VANDENBOUT WITH XESS CORP.
Why finding a good set of naming rules for variables in your HDL code should be considered before everything else.

RTZ - Return to Zero Comic
Renesas Electronics America is a leading semiconductor company that relies on all facets of their technology to come up with unique solutions. We spoke with the vice president of engineering, Ranjit Desphande, about their flagship microcontroller products, maintaining Renesas’ reputation of integrity and quality and how his experience in other fields helps bring a fresh perspective to Renesas’ ever-evolving product line.
What can you tell me about the culture at Renesas?
Worldwide, Renesas is known for integrity, honesty and quality. That’s something that I’ve known by looking from the outside in— I was always impressed by how Renesas was always good at doing what they said they would do. Not just in terms of delivering products that met specifications, but simple stuff like getting your purchase order paid on time. From within the company, what I found is that it’s a culture that permeates every organization. I tried to instill some of that global culture in the team here in the U.S. In addition to that, my style of management coming from a start-up is an open style, meaning every engineer within the organization is absolutely welcome and encouraged to walk in my office and talk about any project they are working on, discuss ideas or bring complaints to my attention. The thing I enjoy the most in this atmosphere is the ability to bounce ideas off of each other. Even though I have the position of VP of engineering, I am still very hands-on—it’s always been the way I am. There are a lot of areas where I like to work on the designs with my engineers, which I feel creates a much better relationship in the management chain so that rather than try and take a solution for a particular customer and generalize it for applications to future products.

What kinds of solutions have you targeted?
The biggest area for us is the signal chain. What I mean by that is everything starting from the sensor. If you were to draw a mental picture, you have sensors that measure real world analog input. The signals from those sensors get conditioned and get fed to a microcontroller or microprocessor, which then analyzes the data and decides to take some action based on that input. As a result of that action, you can activate some sort of actuator somewhere on the other side. This signal chain is the driving principle behind any of our solutions. We’ve worked on several solutions in the last year. Some of the best examples are focused on LED lighting, given that we have some innovative solutions that make use of microcontrollers to do dimming for LED lights. Typically, if you go to Home Depot or a home improvement store and buy a dimmer that traditionally works with the incandescent bulbs, they don’t tend to work well with LED lights or CFL bulbs. We’ve come up with some very innovative solutions that use not just analog and power parts, but also a microcontroller that can adapt dynamically to the characteristics of the bulb that is being dimmed. We’ve also created solutions around motor control, which is another significant area of interest, given our customer profile in appliances and automobiles. All of these are at the heart of several sub-systems for motor controls. What we’ve done is taken some of our leading-edge flagship 32-bit microcontrollers and designed a solution with SiC or power MOSFETs that are also manufactured by Renesas and put together some sophisticated Vector Control algorithms. The result is presented as a complete solution to customers that can then build their particular product or their intellectual property on top of that. It’s another example of going from not just the microcontrollers, but also from the analog and power domain.

What are some of the new products you are developing?
We have had two very successful product launches; the RX, which is our flagship 32-bit microcontroller, and our RL, which is our flagship 16-bit, low-power microcontroller. Just recently we have announced our RX200 line, which is 32-bit processing power with a very low-power footprint. It really scales the RX family from the high-end 600-series down to the low-end. It is very competitive with other suppliers here in the U.S. The other exciting thing we have introduced is the RL, which is the first product that exemplifies the merger synergy we had between

What kind of semiconductor companies will provide anywhere from 40 to 70 percent of their product solution as a building block.
My role is to really foster the development of these solutions based on our microcontrollers and microprocessors, analog and power devices and add software to the mix as well. Coming from the outside, a lot of today’s customers expect that the semiconductor companies will provide anywhere from 40 to 70 percent of their product solution as a building block.

When I first came to Renesas, one of the first products that I worked on had customers that were largely centered in the U.S. I had a unique experience, in my opinion, trying to feed the customer requirements back into the team in Japan and really establish a great relationship.
From an industry perspective, I think the challenge for Renesas is to go from being a high-quality microcontroller and microprocessor component supplier to be more solution-oriented.

with the design team. Because of the fact that I was coming into this job with a totally hands-on technical background, I was able to take requirements and translate them down into the engineering level. That, I think, has really grown. From an engineering standpoint, we’ve done several new product proposals for microcontrollers and analog and power parts. For every product proposal we’ve made for the U.S. region, there’s always two components: an engineering and marketing component. I have been actively involved in certain proposals that have been made in the past three to four months. I’ve also got my application engineering team heavily invested. It’s absolutely important for engineering to be involved because at the end of the day, there are chip designers in Japan who do a great job of manufacturing high-quality products, but the application engineering team is the one that gets to use those products. They see a lot of the issues and requirements that our end customers are going to see. Without that involvement, we would not have the quality and the feature-rich products that we have today. Engineering plays a crucial role in specifying new products.

Could you tell us about the future of Renesas?

Renesas as a company is large and it touches so many different areas of technology that I see a tremendous amount of opportunities. In this decade, we are realizing that more everyday items have some kind of processing element or intelligence written into it. It’s not just your smart meters or smart cars, it’s about your smart home or smart industry where factory automation is getting more and more intelligent. Those are areas where Renesas really plays well into and we are well positioned to get into those domains. From an industry perspective, I think the challenge for Renesas is to go from being a high-quality microcontroller and microprocessor component supplier to be more solution-oriented. To a large extent, the semiconductor industry outside of Intel, especially in Silicon Valley and the U.S. has recognized that they need to be solution-focused. A lot of that has to do with the way the American engineering workforce is structuring their business. A lot of times, people in the engineering workforces are challenged by the number of resources they have, so they are relying more on the semiconductor company and other suppliers to provide more and more of their product solutions. The other interesting challenge for us is connectivity. Renesas has not been known as a pioneer in connectivity solutions and we see the need to build up expertise in the communication domain. I see a lot of new products coming out in the next few years in the connectivity space. It’s an exciting thing that makes me want to come into work everyday.

For more information about Renesas, visit their website:

www.renesas.com
Stereo Audio CODEC with miniDSP

The TLV320AIC3254 (sometimes referred to as the AIC3254) is a flexible, low-power, low-voltage stereo audio codec with programmable inputs and outputs, PowerTune capabilities, fully-programmable miniDSP, fixed predefined and parameterizable signal processing blocks, integrated PLL, integrated LDOs and flexible digital interfaces. The TLV320AIC3254 features two fully-programmable miniDSP cores that support application-specific algorithms in the record and/or the playback path of the device. The miniDSP cores are fully software controlled. For more information, please click here.

I2C No-Offset Bus Buffers

NXP Semiconductors introduced the PCA9525 and PCA9605 — the industry’s first no-offset I2C-bus buffers, which enable system designers to isolate capacitance and interface with other bus buffers. These groundbreaking bus buffers use the no-offset scoreboard method to decide signal direction, rather than using a directional pin and relying on offset voltages to control direction and prevent bus latch-up. Significantly, the no-offset devices are interoperable even with static offset or incremental bus buffers, allowing easy design-in regardless of which other devices are on the bus. For more information, click here.

11MHz Single Supply JFET Amplifier

The OPA140, OPA2140, and OPA4140 op amp family is a series of low-power JFET input amplifiers that feature good drift and low input bias current. The rail-to-rail output swing and input range that includes V– allow designers to take advantage of the low-noise characteristics of JFET amplifiers while also interfacing to modern, single-supply, precision analog-to-digital converters (ADCs) and digital-to-analog converters (DACs). The OPA140 achieves 11MHz unity-gain bandwidth and 20V/µs slew rate while consuming only 1.8mA (typ) of quiescent current. It runs on a single 4.5 to 36V supply or dual ±2.25V to ±18V supplies. For more information, please click here.

Microcontrollers with On-Chip 40nm Flash Memory

Renesas Electronics Corporation announced the RH850/F1x Series of 32-bit microcontrollers (MCUs) for automotive body applications as the first products to be released in the RH850 Family of automotive MCUs with on-chip flash memory employing the industry’s most advanced 40 nanometer (nm) process. The new MCUs are designed for use in a variety of automotive body applications and provide many advantages. The RH850/F1x Series is comprised of three groups and has a total of more than 50 products from Low-end to High-end, the RH850/FIL, RH850/F1M and RH850/F1H. For more information, please click here.
Dean Kamen
Guest Speaker

developing world.

Since high school, Dean Kamen has been innovating.

The Segway, but he

Guest Speaker

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Meet the Experts

Dean Kamen landed in the Silicon Valley, but he has been interested in science since high school, with more than 150 patents and counting. Recent projects include portable energy and water purification for the developing world.

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All too often, scientists and engineers tend to take the process of measuring resistance for granted. All it takes is attaching test leads to a digital multimeter (DMM), setting its function to Resistance, and making the measurement, right? Although that might be true for most resistance measurements, characterizing resistances lower than 10 ohms or higher than mega-ohms is often significantly more complex.

Jonathan Tucker
Senior Marketer And Product Manager
Tektronix/Keithley Instruments

The Highs and Lows of Resistance Measurements:
Can You Trust Your Test?
Ohm’s experimental setup is primitive in comparison with the technology available today to measure resistances, and he was likely unaware of many of the sources of measurement error that can affect the integrity of today’s low-level resistance measurements. Back then, the major sources of measurement error, with which Ohm concerned himself were related to the quality of his wires and their metallurgy. Small impurities in the copper wiring used, for example, later proved to decrease their conductivity substantially.

Today, it’s important to be conscious of potential sources of error such as thermoelectric EMFs and drift, contact resistance, device heating, lead resistances, and leakages. These sources of error are particularly significant at both the bottom and top ends of the resistance testing envelope.

For measuring resistances of less than an ohm, the most widely used technique is to source a current and measure the resulting voltage. The two-wire method shown in Figure 3 is often used to measure resistance. The test current is forced through the test leads and the resistance being measured. The meter then measures the voltage across the resistance through the same set of test leads and computes the resistance value accordingly.

However, for low resistance measurements, the two-wire method presents some problems because the total lead resistance (RLEAD) is added to the measurement. Given that the test current (I) causes a small but significant voltage drop across the lead resistances, the voltage (VM) measured by the instrument won’t be exactly the same as the voltage (VR) directly across the test resistance (R), which can result in considerable error. Typical lead resistances range from one milli-ohm to 1-2 ohms. When attempting to measure resistances lower than these values, the resistance of interest will be completely swamped by the lead resistance. Lead resistance will, in fact, be the dominant source of error. Even when the resistance under test falls into the 10 to 100 ohms range, a two-wire measurement can still produce an inaccurate reading, depending on the level of lead resistance involved.

Because of the limitations of the two-wire method, the four-wire (Kelvin) connection method shown in Figure 4 is generally preferred for low resistance measurements. A DMM, micro-ohmmeter, or a separate current source and voltmeter can be used for these measurements.
With this configuration, the test current (I) is forced through the test resistance (R) through one set of test leads, while the voltage (VM) across the DUT is measured through a second set of leads called sense leads. Although some small current may flow through the sense leads, it is usually negligible and can generally be ignored. The voltage drop across the sense leads is negligible, so the voltage measured by the meter (VM) is essentially the same as the voltage (VR) across the resistance (R). Consequently, the resistance value can be determined much more accurately than with the two-wire method. The voltage-sensing leads should be connected as close to the resistor under test as possible to avoid including the resistance of the test leads in the measurement.

In the next part of this series, I will illustrate the differences and the test results achieved when making a two-wire and four-wire resistance measurement on a printed electronic circuit board that used electronic ink.

![Figure 4: Four-wire resistance measurement model](image)

1.2A High Efficiency Buck-Boost Regulators

**ISL9110, ISL9112**

The ISL9110 and ISL9112 are highly-integrated Buck-Boost switching regulators that accept input voltages either above or below the regulated output voltage. Unlike other Buck-Boost regulators, these regulators automatically transition between operating modes without significant output disturbance.

Both parts are capable of delivering up to 1.2A output current, and provide excellent efficiency due to their fully synchronous 4-switch architecture. No-load quiescent current of only 35µA also optimizes efficiency under light-load conditions. Forced PWM and/or synchronization to an external clock may also be selected for noise sensitive applications.

The ISL9110 is designed for standalone applications and supports 3.3V and 5V fixed output voltages or variable output voltages with an external resistor divider. Output voltages as low as 1V, or as high as 5.2V are supported using an external resistor divider.

The ISL9112 supports a broader set of programmable features that may be accessed via an I²C bus interface. With a programmable output voltage range of 1.9V to 5V, the ISL9112 is ideal for applications requiring dynamically changing supply voltages. A programmable slew rate can be selected to provide smooth transitions between output voltage settings.

The ISL9110 and ISL9112 require only a single inductor and very few external components. Power supply solution size is minimized by a tiny 3mmx3mm package and a 2.5MHz switching frequency, which further reduces the size of external components.

**Features**

- Accepts Input Voltages Above or Below Regulated Output Voltage
- Automatic and Seamless Transitions Between Buck and Boost Modes
- Input Voltage Range: 1.8V to 5.5V
- Output Current: Up to 1.2A
- High Efficiency: Up to 95%
- 35µA Quiescent Current Maximizes Light-load Efficiency
- 2.5MHz Switching Frequency Minimizes External Component Size
- Selectable Forced PWM Mode and External Synchronization
- I²C Interface (ISL9112)
- Fully Protected for Overcurrent, Over-temperature and Undervoltage
- Small 3mmx3mm TDFN Package

**Applications**

- Regulated 3.3V from a Single Li-Ion Battery
- Smart Phones and Tablet Computers
- Handheld Devices
- Point-of-Load Regulators

**Related Literature**

- See AN1648 "ISL9110IRTNEVAL1Z, ISL9110IRT7EVAL1Z, ISL9110IRTAEVAL1Z Evaluation Board User Guide”
- See AN1647 "ISL9112IRTNEVAL1Z, ISL9112IRT7EVAL1Z, ISL9112IRTAEVAL1Z Evaluation Board User Guide”

**Figure 1. TYPICAL APPLICATION**

**Figure 2. EFFICIENCY**
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library ieee;
use ieee.std_logic_1164.all;

entity AND_GATE is
port(   A: in std_logic;
       B: in std_logic;
       F1: out std_logic
    );
end AND_GATE;

architecture behv of AND_GATE is
begin
process(A,B)
begin
end process(A,B)
begin

When you’re writing your HDL code, what consideration should be top-of-mind?

Creating a good hierarchy?

Maintaining a synchronous design?

Registering inputs and outputs?

I’ll suggest a more basic concern: finding good names for stuff.

XESS Corp. - Founder
The HDL code itself would help to tell the story about who the circuit is doing. Good names carry along the meaning of the problem the design is meant to solve, so it’s easier to load the problem into your head. Then you’ll spend less mental energy translating the variables back into the problem domain and more on producing correct code.

Your debugging sessions would be easier.

For the same reason, it’s easier to find errors when the debugger shows variables whose names refer directly to items in the problem domain.

Your designs would be re-used more often.

If a design is easier for you to understand and modify, others will be more likely to use it as well.

Here’s another indication of the importance of naming: “The Power of Variable Names” in Code Complete is 25% longer than any other chapter. You could stop reading this right now and go read that chapter, but I’ll synopsize the germane points for you:

A variable name should describe what it represents.

For example, heightOfAscent would be a good name for a variable in a telemetry module that records the current altitude of a rocket. Not so for a variable named h or (even worse) x.

A variable should refer to the problem domain, not the implementation.

For example, naming a variable heightCounter implies that the rocket’s altitude is maintained within a counter. This speaks to how the altitude is computed within the circuit, but that may change as the design’s implementation changes. You don’t want to have to change your variable names if your logic changes or — worse yet — have your names give misleading information about how the design works.

Variable names should be between 10 and 16 characters.

This makes the variables easiest to comprehend while still conveying meaning (although you can stretch this to 32-20 chars with only slightly worse results). Of course, variable names that describe the problem domain can get rather long (heightOfAscent is already at 14 characters), so you’ll have to employ some techniques to shorten them like removing nonleading vowels (heightOfAscent) and removing articles (heightAscent).

The greater the scope of the variable, the more descriptive the name should be.

For example, you can use i as the index in a short generate loop but not for a 1000-line block of code (well, nothing would be appropriate for that).

In addition to the general principles shown above, I also have conventions for how I adorn names in my VHDL code. I use capitalization and append suffixes to make it easier and faster for me to generate meaningful, consistent names. It also indicates where the signals come from and where they can be used.

Here are the rules I use:

- Entities, architectures, procedures, functions, types: CamelCase with an initial uppercase letter.
- Packages: CamelCase with an initial uppercase letter.
- Signals & variables: CamelCase with an initial lowercase letter and one or more of the following suffixes:
  - _i: Input port.
  - _o: Output port.
  - _e: Signal local to architecture.
  - _v: Variable local to process.
  - _b: Active-low (complementary) signal.
  - _r: Current register value.
  - _x: Next register value after clock edge.
  - _s: Signal local to architecture.
  - _d: Delayed version of signal.
  - _a: Asynchronous signal.
  - _n: Enable version of signal.
  - _g: Enabled version of signal.
- The comments in the code show some of the places where my naming conventions help out. But there are also a couple of places where I violate my conventions:
  - I use short, non-descriptive names for the a_i and b_i inputs. In my defense, there aren’t any really good names for these since this just a module for performing a general-purpose calculation that would be used in some larger application. I also tried to mitigate this by placing AmuSb in the output names to show that the difference of these two inputs is what’s being worked with.
  - I violated the CamelCase naming format for some of the signals such as intgrlAminusB_r because the correct version, intgrlAmuSb_r looked rather odd and was hard to read.

These violations demonstrate the last and most important naming convention: don’t be a prig! These rules exist to serve you and not the other way around. If you find places where they make the code less clear, then either violate them or change the conventions to account for these new circumstances. There’s no reason for slavish adherence to some standard if it generates poor code.
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