ROBOTIC VACUUM: OVERVIEW

One of the most popular home automation solutions, the vacuum robot, is a rapidly growing consumer appliance. With the ability to autonomously clean residential or small commercial spaces, it provides a useful addition to a smart connected home. This design allows the flexibility and scalability to integrate many control algorithm for mapping, routing recorder, border sensing, obstacle detection, battery energy monitoring, navigate of auto-charging, and multi-motor control. Within the battery charging base board, the key design is an integrated battery charger control, sub-GHz communication control with a base control board and WiFi for connection to the smart home. Within the vacuum base control board, multiple sensors are integrated, enabling autonomous operation along with communication interfaces and BLDC motor control.

This solution can support sub-GHz communication with the RL78/G1H between the charger board and base control board, drive the BLDC with ZAMC4100 and efficiently manage power with the ISL85413/ ISL85403/ISL80510.
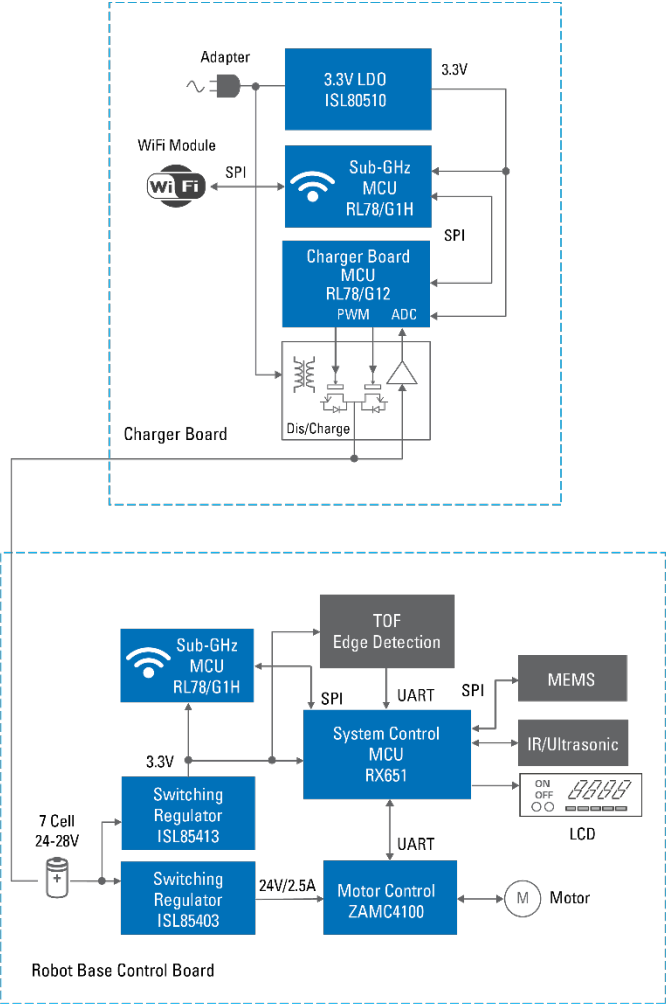
Key Features:

- Highly integrated ZAMC4100 includes MCU + Driver + MOSFET

- Integrated sub-GHz with RL78/G1H MCU

- Rich communication interface with RX651 MCU

WC#: CN001-AB4

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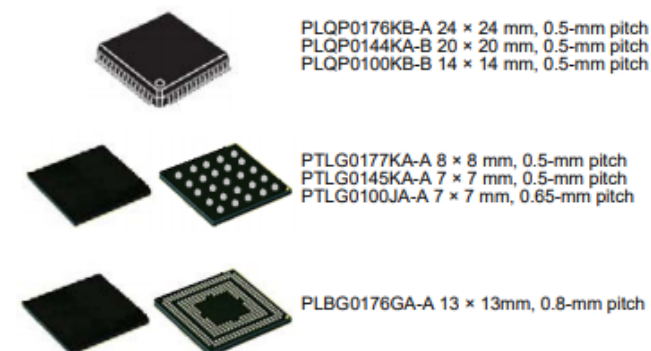# ROBOTIC VACUUM: BLOCK DIAGRAM

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RX651: COMMUNICATION MCU WITH ENHANCED SECURITY

Communication MCU with RXv2 core and large capacity RAM

Features	Benefits	Applications
• 32-bit MCU @ 120MHz • Ideal to carry out high-speed communication processing that is required for various communication interfaces such as Ethernet(RX65N only), USB, CAN, SD host/slave interface, and quad SPI. • Large-capacity memory of up to 2MB Flash and 640kB RAM • 100pin – 177pin packages	• RX65N and RX651 Groups are new mainstream RX microcontrollers with RXv2 core, large-capacity RAM, and enhanced security, connectivity, and HMI. • Cost optimized due to latest 40nm process technology	• Process controls and monitoring • Oil and Gas leak detection • HVAC and air control systems • CPAP and respiratory devices • Breathalyzer • Automotive MAF • Air speed and wind meter • Liquid dispensing/metering systems • Medical infusion pumps

Typical application and key performances

120-MHz 32-bit RX MCU, on-chip FPU, 240 DMIPS, up to 2-MB flash memory (supportive of the dual bank function), 640-KB SRAM, various communications interfaces including Ethernet MAC (RX65N only),
SD host interface (optional), SD slave interface (optional), quad SPI, and CAN, 12-bit A/D converter, RTC, Encryption functions (optional), CMOS camera interface, Graphic-LCD controller, 2D drawing engine

PLQP0176KB-A 24 × 24 mm, 0.5-mm pitch
PLQP0144KA-B 20 × 20 mm, 0.5-mm pitch
PLQP0100KB-B 14 × 14 mm, 0.5-mm pitch

PTLG0177KA-A 8 × 8 mm, 0.5-mm pitch
PTLG0145KA-A 7 × 7 mm, 0.5-mm pitch
PTLG0100JA-A 7 × 7 mm, 0.65-mm pitch

PLBG0176GA-A 13 × 13mm, 0.8-mm pitch

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RX231: 32 BIT, WIDE VIN MCU WITH BUILT-IN FPU

Motor Control MCU series within the RX Family

Features	Benefits	Applications
• 32-bit MCU @ 54MHz • RX231 microcontrollers operate in a broad voltage range from 2.7 V to 5.5 V • Have rich communication interface such as SD host interface, USB, and CAN • Integrated with security function, encryption function, and touch key. • Up to 512kB Flash and 64kB RAM • 48pin, 64pin and 100pin LQFP packages	• The RX231 Group is 32-bit microcontroller with built-in FPU (floating-point processing unit) that enables it to easily program complex inverter control algorithms. RX24T Group enables simultaneous control of up to 3 motors by max 80 MHz operating frequency CPU core and motor control peripherals.	• Industrial automation • Industrial process control • Office Automation • Home Appliance • Healthcare • IoT

Typical application and key performances

54-MHz 32-bit RX MCUs, built-in FPU, 88.56 DMIPS, up to 512-KB flash memory, up to 14 communication functions including USB 2.0 full-speed host/function/OTG, CAN, SD host interface, serial sound interface, cap-touch, 12-bit A/D, 12-bit D/A, RTC, AES, MPU security functions
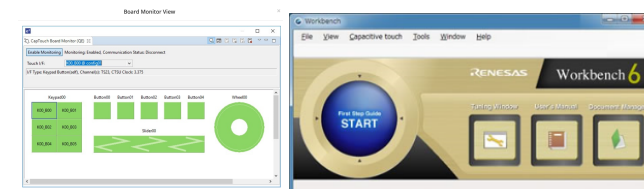
PLQP0100KB-B   14 × 14 mm, 0.5 mm pitch
PLQP0064KB-C   10 × 10 mm, 0.5 mm pitch
PLQP0048KB-B   7 × 7 mm, 0.5 mm pitch

PWQN0064KC-A 9 × 9 mm, 0.5 mm pitch
PWQN0048KB-A 7 × 7 mm, 0.5 mm pitch

PTLG0100KA-A   5.5 × 5.5 mm, 0.5 mm pitch
PWLG0064KA-A   5 × 5 mm, 0.5 mm pitch

Capacitive Touch Development Tool: "QE for Capacitive Touch" or "Workbench6"

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RL78/G1H: LOW POWER 16 BIT 32MHZ MCU

Industry's Lowest Power SubGHz wireless communication MCU within the RL78 Family

Features	Benefits	Applications
• True Low Power 16bit 32MHz uC • Targeted for IEEE802.15.4e/g compliant applications (Wi-SUN) • High Performance w/ 1.8V to 3.6V operation • Industry lowest level power consumption • Convenient starter kits • Software stacks certified by the Wi-SUN Alliance	• Industry lowest level power consumption - 5.8 mA (3.3 V) at Stand-by mode in RF receipt. • Built in circuit elements for antenna simplify circuit design and reduces system cost, reduced CPU load • Offer transceiver RAA604S00 conforming to IEEE802.15.4e/g that can be used in combination with microcontroller	• IEEE802.15.4e/g • Smart Gird • Smart meter • Building management and lighting • Infrastructure monitoring • Smart Home • Healthy Monitoring

Typical application and key performances

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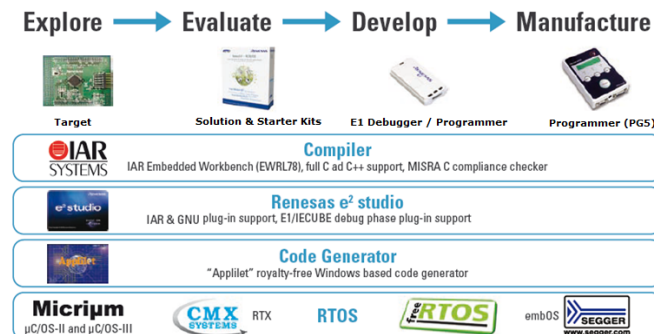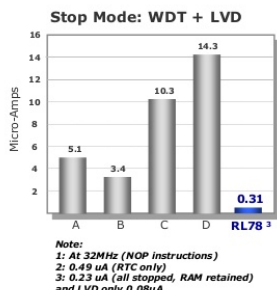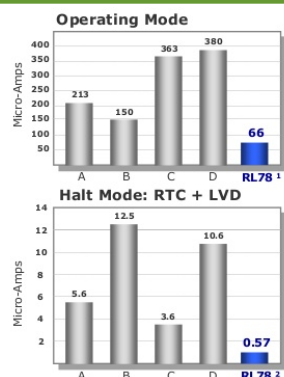
RL78/G12: COMPACT GENERAL PURPOSE MCU

Compact, low power, high function general-purpose MCU series within the RL78 Family

Features	Benefits	Applications
• True Low Power 16bit 24MHz uC • Compact 20/24/30pin/2-16KB FLASH/256B-2KB RAM options • High Performance w/ 1.8V to 5.5V operation • High Integration including oscillators, power-on-reset, low voltage detection, watchdog, real time clocks and analog functions • Comprehensive Tools and Support – Advanced Tools, 3rd Party, Online resources and training	• RL78 provide many options in-order to scale power based on application requirements by using combination of the clock selection and advanced power modes. • RL78 offer scalability via > 600 devices with wide pin count, packages, I/O peripheral mapping and large memory options • Integration options allow for many of the functions necessary to make the solution smaller, more reliable and lower cost	• sub-microcontrollers • small appliances • General consumer appliance • General industrial appliance

Typical application and key performances

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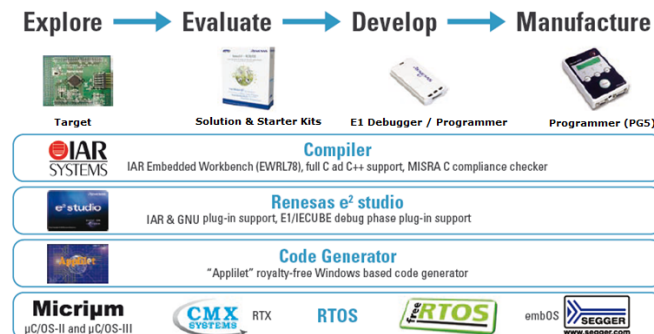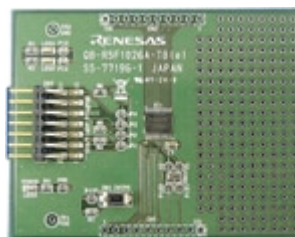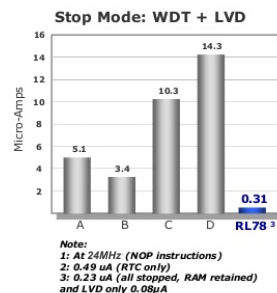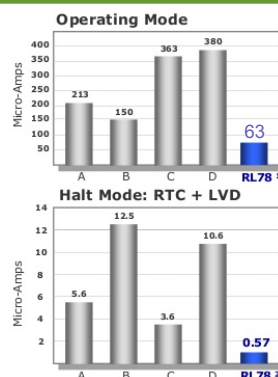
ISL80510: SINGLE OUTPUT LOW DROPOUT REGULATOR

High performance 5V/1A LDO

| Features	Benefits	Applications
• Input voltage 2.2V to 6V • Output voltage 0.8V to 5.5V • ±1.8% Vout accuracy over line, load and temperature variation • Very low 130mV dropout voltage at VOUT = 2.5V • Programmable output soft-start time	• Thermally enhanced 8LD DFN package • Programmable soft start • Very fast transient response • It achieves a very fast load transient response and excellent PSRR	• Noise-sensitive instrumentation systems • Post regulation of switched mode power supplies • Industrial systems • Medical equipment • Telecommunications and networking equipment • Servers • Hard disk drives (HD/HDD)

Typical application and key performances

Typical application circuit

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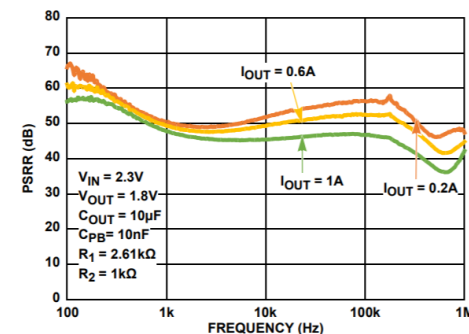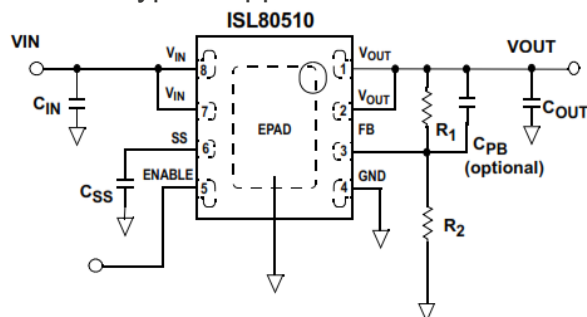
ISL85413: COMPENSATION FREE, HIGH EFFICIENCY REGULATOR

Wide VIN 300mA Synchronous Buck Regulator

| Features	Benefits	Applications
• Wide input voltage range of 3.5V to 40V • Synchronous operation for high efficiency • No compensation required • Selectable PFM or forced PWM mode at light loads • Internal switching frequency 700kHz • Continuous output current up to 300mA • Internal soft-start	• The ISL85413 integrates both high-side and low-side NMOS FETs and features a PFM mode for improved efficiency at light loads • With the wide VIN range and reduced BOM, the part provides an easy to implement design solution for a variety of applications while giving superior performance. • It will provide a very robust design for high voltage industrial applications as well as an efficient solution for battery power applications.	• Industrial control • Medical devices • Portable instrumentation • Distributed power supplies • Cloud infrastructure

Typical application and key performances

Typical application circuit

Efficiency Vs. Load

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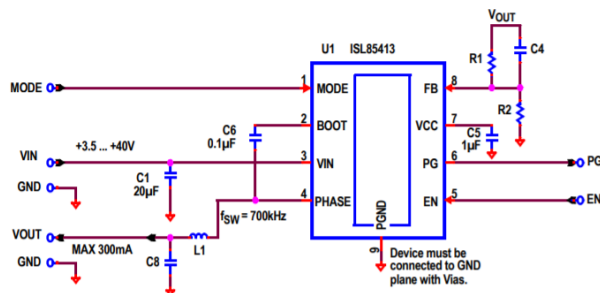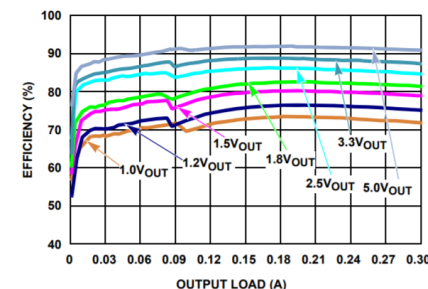
ISL85403: 40V/2.5A MOSFET+BUCK/BUCK-BOOST CONVERTER

Wide VIN 2.5A Synchronous Buck Regulator

| Features	Benefits	Applications
• Wide input voltage range of 3V to 40V • Boost mode operating Vin lower than 2.5V • Selectable Forced PWM mode or PFM mode • 300uA Iq(PFM no load), 5uA Iq @shutdown • Operation topology: Syn-Buck, Non-Syn-Buck, Boost-Buck, buck-boost • Programable switching frequency 0.2-2.2MHz • Overcurrent protection: Temperature compensated current sense, cycle by cycle current limiting with frequency foldback, hiccup mode for worst case short condition	• The ISL85403 integrates high-side MOSFET and low-side driver • The ISL85403 has a flexible selection of Forced PWM mode and PFM mode • The low-side driver can either be used to drive an external low-side MOSFET for a synchronous buck or left unused for a standard non-synchronous buck. • The ISL85403 has comprehensive protections against various faults including overvoltage and over-temperature protection.	• General purpose • 24V bus power • Battery power • Point of Load • Embedded processor and I/O supplies

Typical application and key performances

Typical application circuit

Efficiency Vs. Load

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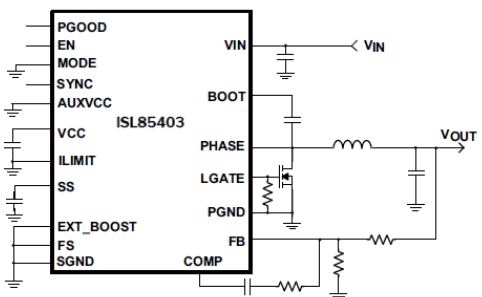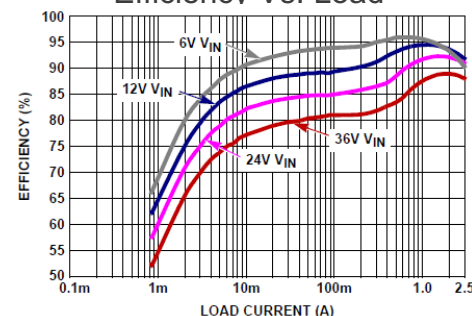
ZAMC4100: ACTUATOR AND MOTOR CONTROLLER

integrates an ARM® Cortex™-M0 core MCU and eight power stages with integrated MOSFETs

| Features	Benefits	Applications
• ARM® Cortex™-M0 core MCU • 10bit ADC, 6bit DAC, PWM, SPI, UART, LIN2.1, GPIO, • 4 low RDS (ON) half-bridge drivers and 4 low • RDS (ON) high-side switches • Support normal & Sleep mode • All output short protection and open/short diagnostic • Over temperature, over voltage, over current protection and auto-driver shutdown	• ZAMC4100 is Multi-chip-module concept with high functional integrity. • Low external components & small FQN with exposed pad for thermal management • Smart power management for low sleep Ic(<80uA)	• Intelligent DC motor drivers • Stand alone or slave actuator controller • Power management for low voltage electronical system • Single chip solution for optimize write goods controller.

Typical application and key performances

Typical application circuit
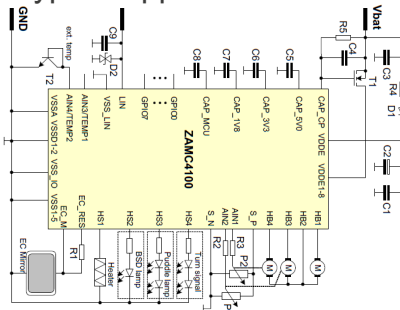
ZAMC4100 Evaluation Board – Connector and Jumper Description

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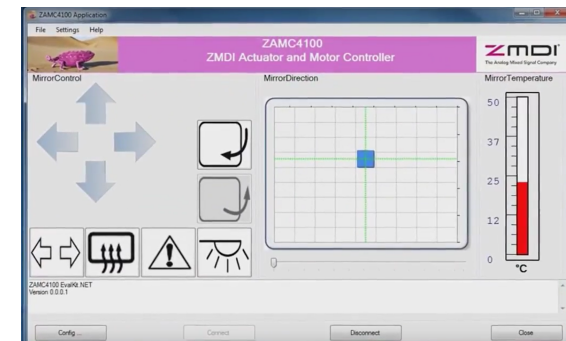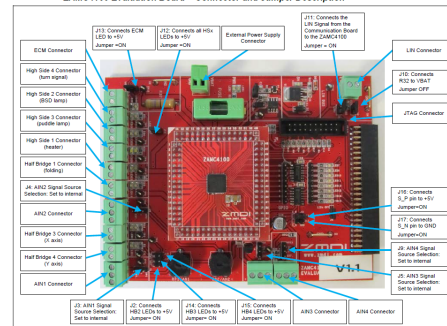
ROBOTIC VACUUM

- **System benefits**
  - Integrated motor controller with internal MCU+Driver+MOSFET
  - The high performance control MCU, Low Power MCU, Support Sub-G RL78/G1H
  - High performance adjustable DC/DC

Device Category	P/N	Key Features
MCU	RX651	RXv2 Core, FPU, DSP, Max to 120 MHz, 640K RAM, TFT-LCDC, Rich Communication.
MCU	RX231	RXv2 Core, FPU, DSP, 48pin, 256K Flash, Rich Communication.
MCU	RL78/G1H	RL78 Core, 64pin, 512K Flash, supports IEEE802.15.4e/g and has industry's lowest power consumption - min. 5.8 mA (3.3 V) at Stand-by mode in RF receipt.
MCU	RL78/G12	RL78 Core, 30pin, 16K Flash, Low power MCU.
Power	ISL80510	High Performance 1A LDO, programmed Vout 0.8V to 5.5V.
Power	ISL85403	ISL85403, 40V, 2.5A synchronous buck or boost-buck controller with an integrated high-side MOSFET and low-side driver.
Power	ISL85413	ISL85413, 40V, 300mA buck switching regulator with integrated FETs.
Analog	ZAMC4100	ARM® Cortex™-M0 microcontroller; 8 power stages with integrated MOSFETs; SPI, UART and LIN2.1; 8 GPIO; 4 analog inputs; all in a single package.

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