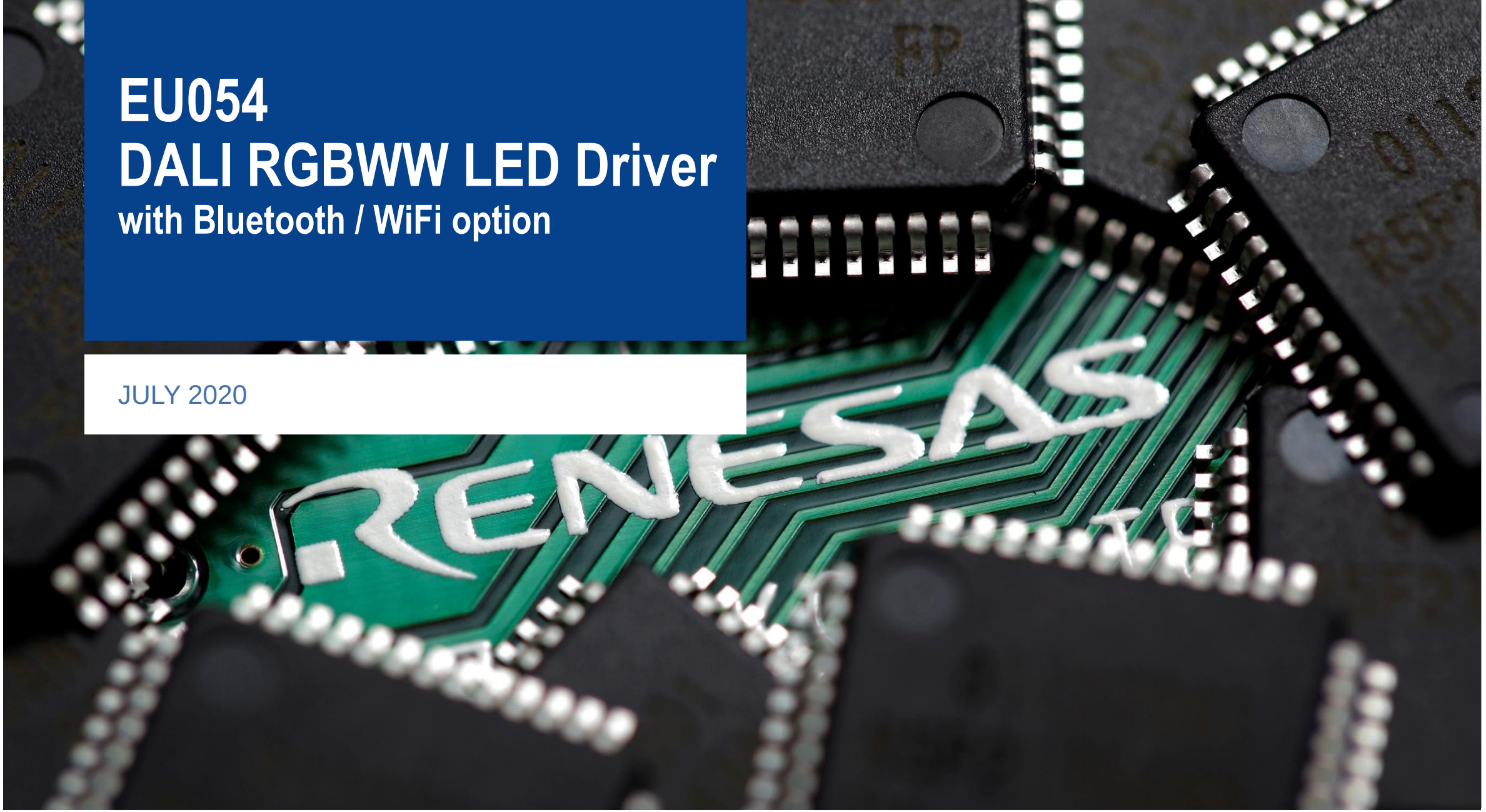
EU054
DALI RGBWW LED Driver
with Bluetooth / WiFi option

JULY 2020



BIG IDEAS FOR EVERY SPACE RENESAS

DALI RGBWW LED Driver

- **Overview**

The digital addressable lighting interface (DALI) is becoming more and more popular for home and building lighting applications. The standard enables simple wiring and options to change configurations. The latest DALI 2.0 standard allows users to control up to 65 individual lights and/or 32 groups of lights. Complex color light scenes of multiple luminaires can now easily be set up through DALI. For this reference design, energy efficiency LEDs are used, often arranged in stripes. For ambient lighting, RGB is preferred, but for general lighting, warm/cold white light is needed.

Renesas offers a highly integrated, complete solution for driving five LED stripes for red, green, blue, and warm/cold white lights, with up 70V and 700mA each, resulting in 245W of total LED power. The 70V are internally boosted out of the 24VDC input.

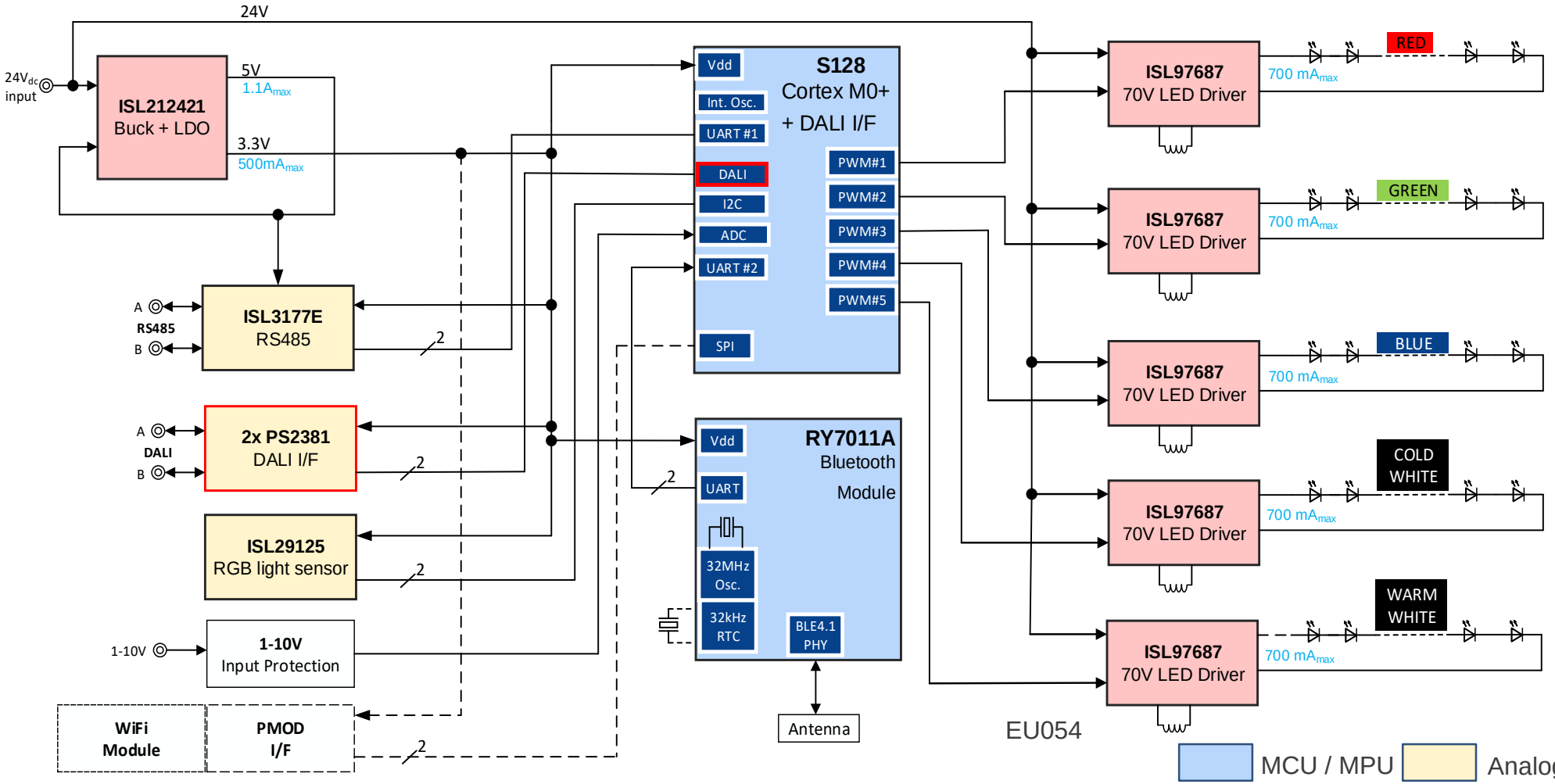
Renesas' Synergy S128 microcontroller (MCU) already contains a dedicated peripheral for DALI 2.0, so the total BOM is further reduced. Renesas also provides a best-in-class power solution to run the system out of the standard 24VDC.

- **System Benefits:**
  - RGBWW drivers for up to 5* 70V/700mA = 245W LED ~ 25.000 Lumen
  - Rich interfaces include the DALI 2.0 interface (peripheral included in the S128 MCU), RS485 interface, and PMOD adapter to add wireless connectivity (e.g. Bluetooth or WiFi) - all on a 24VDC power supply and low BOM count

EU054

DALI RGBWW LED Driver

70V x 700mA x 5ch = 245W



DALI RGBWW LED Driver

Device Category	P/N	Key Features
MCU	S128	ARM® M0+ core-based MCU w/ integrated DALI 2.0 peripheral
	RY7011A	Bluetooth 4.1 Module (for low volumes and quick evaluation)
Power	RAA212421	1.1A buck regulator + 500mA LDO
	ISL97687	70V / 700mA LED driver with integrated boost regulator (e.g. 24V supply)
Analog	PS2381	Optocoupler
	ISL3177E	RS485 (without galvanic isolation)
	ISL29125	RGB light sensor with I^2C interface

EU054

S128 – Ultra-Low Power 32-MHz Arm®Cortex ®-M0+ Core

For Control Applications Requiring Low Power Operation Modes and Fast Wake-up Times

High Performance

- 32MHz Arm® Cortex®-M0+ CPU
- Up to 256-KB code flash, 24-KB SRAM

Smart Mix of Analog Functions

- Op Amp x 4, Temperature Sensor (TSN)
- 14-Bit SAR ADC (21 ch.), 8-Bit DAC (3 ch.)
- High-Speed Comparator x 3, Low-Power Comparator x 3

Communication Interfaces

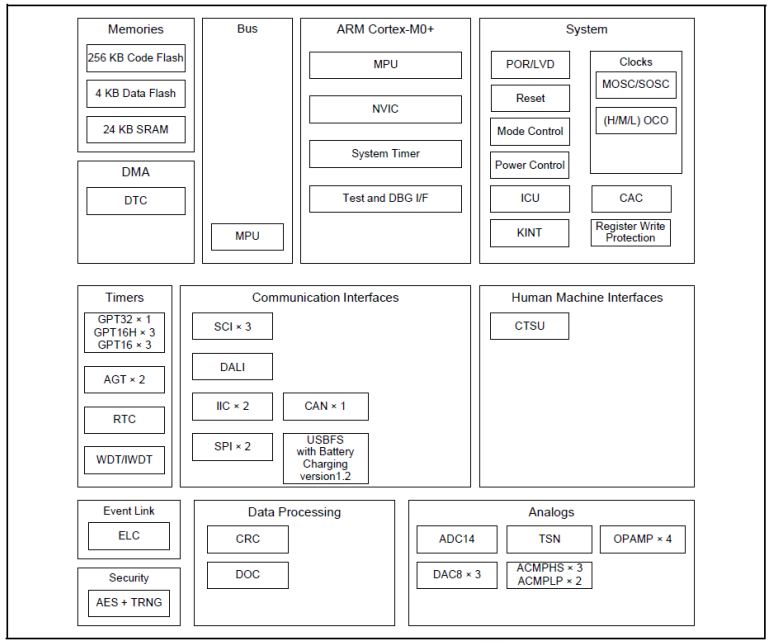
- USB 2.0 (Full Speed), CAN, SCI x 3/SPI x 2/IIC x 2
- Digital Addressable Lighting Interface (DALI)

HMI Interface

- Capacitive Touch Sensing Unit (28 ch.)

Wide Voltage and Low Power Consumption

- Wide operating voltage range of 1.6V to 5.5V
- Various Low Power Modes



Part #	CTSU(ch)	OPA(ch)	Temp.(°C)	Package
R7FS128783A01CFM	28	4	-40 to 105	64-pin LQFP
R7FS128783A01CFL	21	3	-40 to 105	48-pin LQFP
R7FS128783A01CNE	21	3	-40 to 105	48-pin QFN
R7FS128782A01CLM	12	3	-40 to 85	36-pin LGA
R7FS128783A01CFJ	9	2	-40 to 105	32-pin LQFP
R7FS128783A01CNG	9	2	-40 to 105	32-pin QFN

RY7011 – Bluetooth® Low Energy Module

Compact Module with Built-in 32 MHz Crystal Resonator for RF and Antenna

Bluetooth®

High Integration

- The RL78/G1D module (RY7011) contains the RL78/G1D, a 32 MHz crystal resonator for RF chips, and an antenna, all in a compact (8.95 x 13.35 x 1.7 mm) module
- GPIO 24 pins mounted - these can use the UART,I2C, SPI, Timer, ADC.
- RF transceiver is certified with Bluetooth® v4.2 Specification (Low Energy single mode)

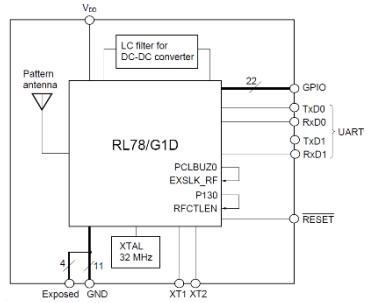
Easy to Develop and Use

- The module has been tested and found to comply with global regulatory certification for Japan, FCC, IC, and CE, as well as Bluetooth SIG certification
- The module inherits the functional pins of the RL78/G1D, so not only can you use it for modem configuration, but you can also leverage the strengths of the microcontroller for embedded configuration

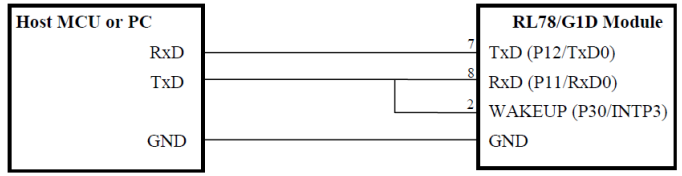
Low Power Consumption

- RL78/G1D module supports Bluetooth® Low Energy and provides the lowest level of current consumption in the industry
  - RF transmitter active normal mode: 4.3 mA, Low power mode: 2.6 mA
  - RF receiver active normal mode: 3.5 mA
  - Average current: 9.1 µA (1-second intervals, connection maintained, CC-RL compiler)

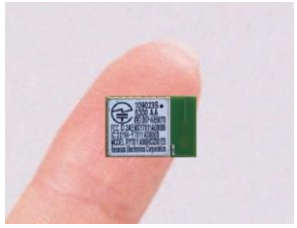
Part #	Flash ROM	RAM	Package
RY7011A0000DZ00	256KB	20KB	42-pin LGA (8.95 × 13.35mm)



RL78/G1D module (RY7011) Block Figure



Connections to the host microcontroller



RL78/G1D module (RY7011)
(RY7011A000DZ00)
Size: 8.95 × 13.35 × 1.7 mm

RAA212421 – Dual-Output Regulator

40VIn, 1.1A Buck Regulator w/ Integrated 500mA LDO

Key features

- Wide input voltage range of 3V to 40V
- Synchronous operation for high efficiency
- Integrated high-side and low-side NMOS devices
- Selectable PFM or PWM mode at light loads
- Internal frequency (500kHz) or adjustable switching frequency (300kHz to 2MHz)
- Continuous output current up to 1.1A
- Internal or external soft-start
- Power-good and enable functions
- 500mA low dropout linear regulator
- 1.8V to 6V input
- ±1.8% V_{OUT} accuracy ensured over line, load, and T_J = -40°C to +125°C
- Very low 45mV dropout voltage at V_{OUT} = 2.5V
- Excellent PSRR over wide frequency range
- Programmable output soft-start time
- Very fast transient response
- Current limit protection

Part #	VIN	T&R Qty	Package
RAA2124214GNP#AA0	3V to 40V	-	3 x 6mm, 22TDFN
RAA2124214GNP#HA0	3V to 40V	6K	3 x 6mm, 22TDFN
RAA2124214GNP#MA0	3V to 40V	250	3 x 6mm, 22TDFN

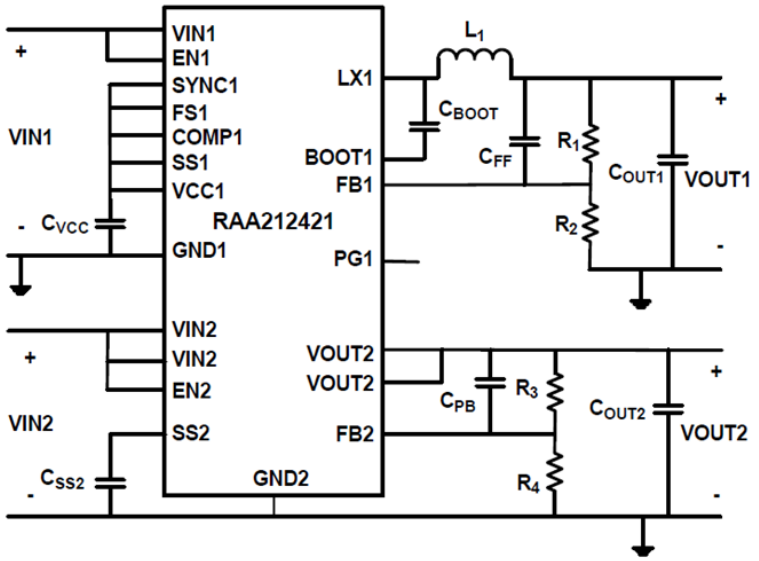
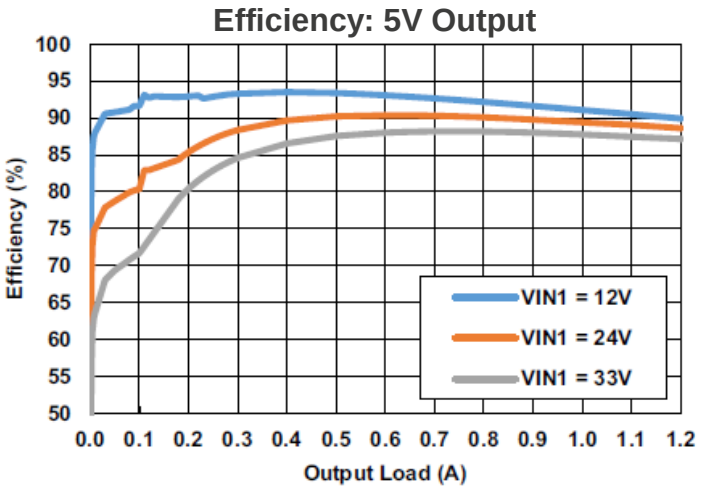


Figure 1. Typical Application

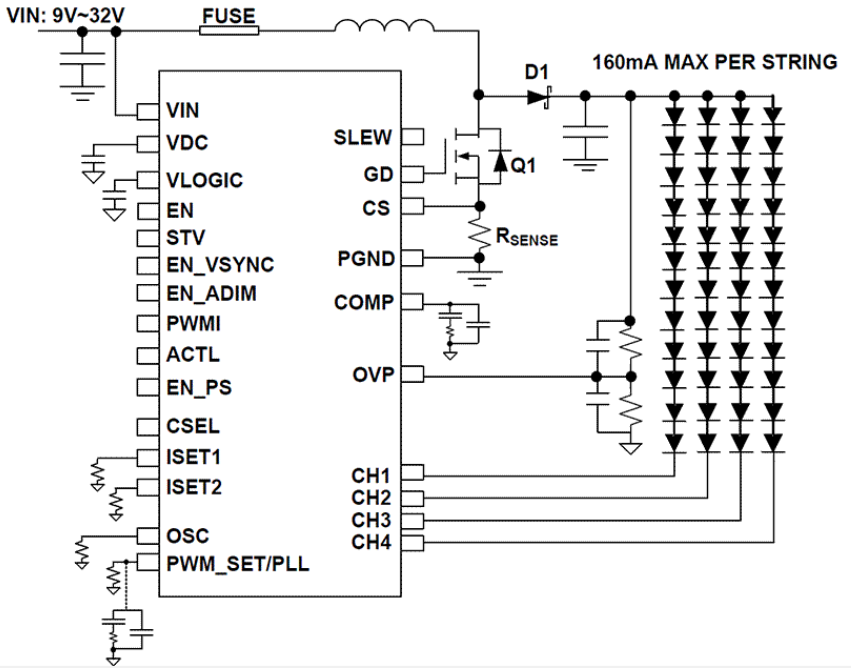


ISL97687 – LED Driver

4-Channel LED Driver with Phase Shift Control and 10-Bit Dimming Resolution

Features

- 4x160mA, 75V rated channels with integrated channel regulation FETs
- Channels can be ganged for high current
  - 2x350mA
  - 1x700mA
- 9-32V input voltage
- Dimming modes:
  - Direct PWM dimming from 100Hz ~ 30kHz
  - PWM dimming with adjustable output frequency
    - 10-bit dimming resolution
    - V_{SYNC} function to synchronize PWM signal to frame rate
    - Phase shift
  - Analog to PWM dimming with 8-bit resolution
- 2 selectable current levels for 3D applications
- Current matching of ±1%
- Integrated fault protection features such as string open circuit protection, string short-circuit protection, overvoltage protection, and over-temperature protection
- 28 Ld 5mmx5mm TQFN and 28 Ld 300mil SOIC packages available



Part #	Package
ISL97687IRTZ-T	28 Ld 5x5 TQFN
ISL976787IBZ-T	28 Ld SOIC (300mil)

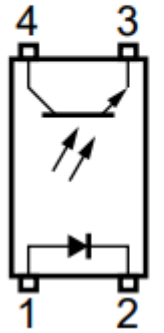
PS2381 – Photocoupler

4-PIN LSOP Photocoupler

Key Features

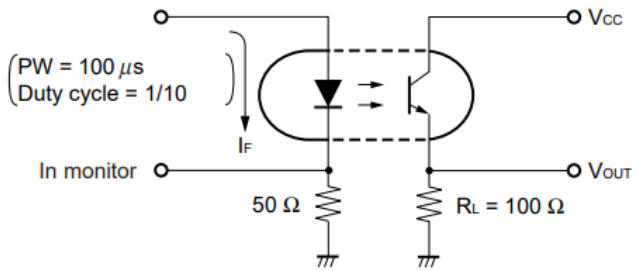
- Operating ambient temperature: 115°C
- Isolation distance 0.4mm$_{min}$, creepage / air distance 8mm
- High isolation voltage BV = 5 000 V_{rms}
- 4-pin LSOP (Long Mini-Flat Small Outline Package) type
- High-speed switching (t_r = 4 µs$_{typ.}$, t_f = 5 µs$_{typ}$)
- Embossed tape product: PS2381-1-F3: 3.000 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: No. E72422
  - CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
  - SEMKO approved (EN 60065, EN 60950)
  - DIN EN 60747-5-5 (VDE 0884-5) approved (Option)
  - CQC approved (GB8898, GB4943)

PIN CONNECTION
(Top View)



1. Anode
2. Cathode
3. Emitter
4. Collector

*2. Test circuit for switching time



Part #	Order #	Safety Standard
PS2381-1-F3	PS2381-1Y-F3-AX	UL, CSA, SEMKO, CQC approved)
PS2381-1-V-F3	PS2381-1Y-V-F3-AX	UL, CSA, SEMKO, CQC approved DIN EN 60747-5-5 (VDE 0884-5) approved

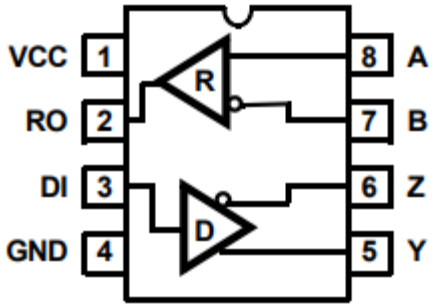
ISL3177E – RS-485 Transceiver

±15kV IEC ESD Protected, 3.3V, Full-duplex, 20Mbps RS-485/RS-422 Transceiver

Features

- IEC61000 ESD protection on RS-485 I/O pins ±15kV
- Class 3 ESD level on all other pins >7kV HBM
- Full fail-safe (open, short, terminated/floating) receivers
- True 1/8 unit load allows up to 256 devices on the bus
- Single 3.3V supply
- High data rate, up to 20Mbps
- Low quiescent supply current, 800µA max.
- Ultra low shutdown supply current 10nA
- -7V to +12V common-mode input/output voltage range
- Three state Rx and Tx outputs available
- Current limiting and thermal shutdown for driver overload protection
- Tiny MSOP packages consume 50% less board space
- Pb-free (RoHS compliant)

ISL3171E, ISL3174E, ISL3177E
(8 LD MSOP, SOIC)
TOP VIEW



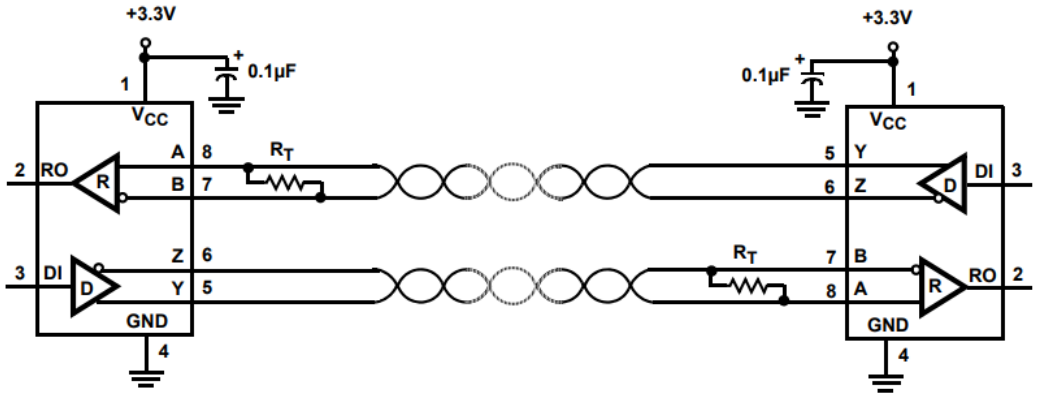


FIGURE 2. ISL3171E, ISL3174E, ISL3177E

Part #	HALF/FULL DUPLEX	Data Rate Mbps	Package
ISL3177EIUZ	Full	20	8 Ld MSOP

ISL29125 – RGB Color Light Sensor

Digital RGB Color Light Sensor with IR Blocking Filter

High Sensitivity, Accurate and Flexible Design

- Selectable range (Via I²C)
- I²C (SMBus compatible) output
- ADC resolution 16 bits
- Programmable interrupt windows
- Two optical sensitivity ranges:

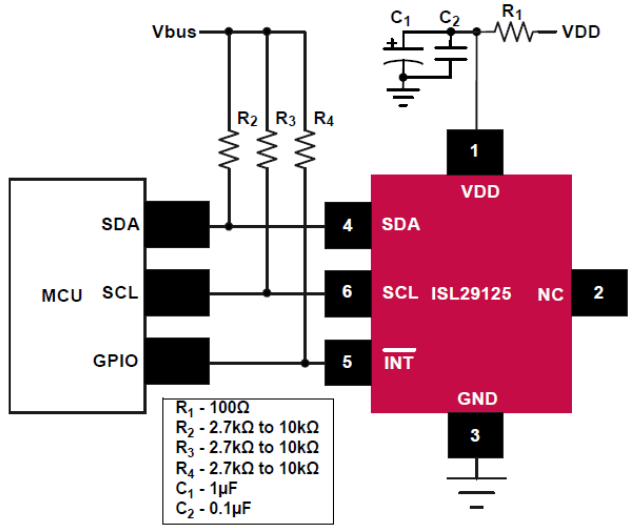
  Range 0 = 5.7m lux to 375 lux

  Range 1 = 0.152 lux to 10,000 lux

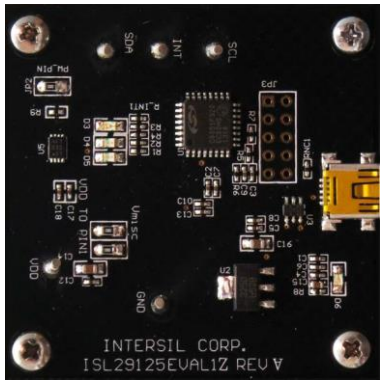
Low Power and Small Package

- 56µA operating current, 0.5µA shutdown current
- Operating power supply 2.25 to 3.63V
- I²C power supply 1.7V to 3.63V
- 6 Ld ODFN (1.65x1.65x0.7mm) package

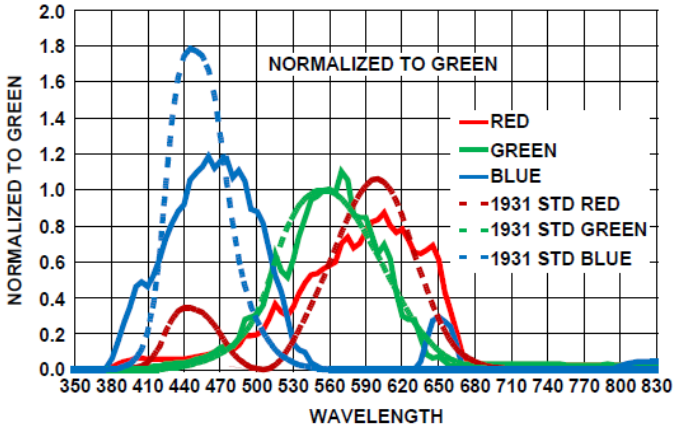
Part #	Temp range	Tape and Reel Quantity	Package
ISL29125IROZ-T7	-40 to 85 °C	3000	6 Ld 1.65 x 1.65 ODFN
ISL29125IROZ-T7A	-40 to 85 °C	250	6 Ld 1.65 x 1.65 ODFN



Typical Application Diagram



ISL29125EVAL1Z Evaluation Board



Normalized Spectral Response for RGB Sensing

Renesas.com