JP144
Smart Kitchen Appliance HMI

August 2020

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Smart Kitchen Appliance HMI

▪ Overview

Smart kitchen appliances have several features, such as color display, touch control and sound feedback. Voice recognition is also an emerging feature for non-contact operation. Sensing functions such as humidity/temperature and gas, can also be added on as an additional feature to these systems.

This reference design shows a multi-HMI function control and sensing solution, with the RA6M3 32-bit microcontroller (MCU) consolidating system control.

▪ System Benefits

- Single-chip MCU, reduced bill-of-materials (BOM) cost and PCB size
- High-performance HMI (voice recognition, graphic and sound feedback/adaptive differential pulse-code modulation) can be controlled in one chip
- High-performance LDO, gas sensor and temperature/humidity sensor for an integrated solution

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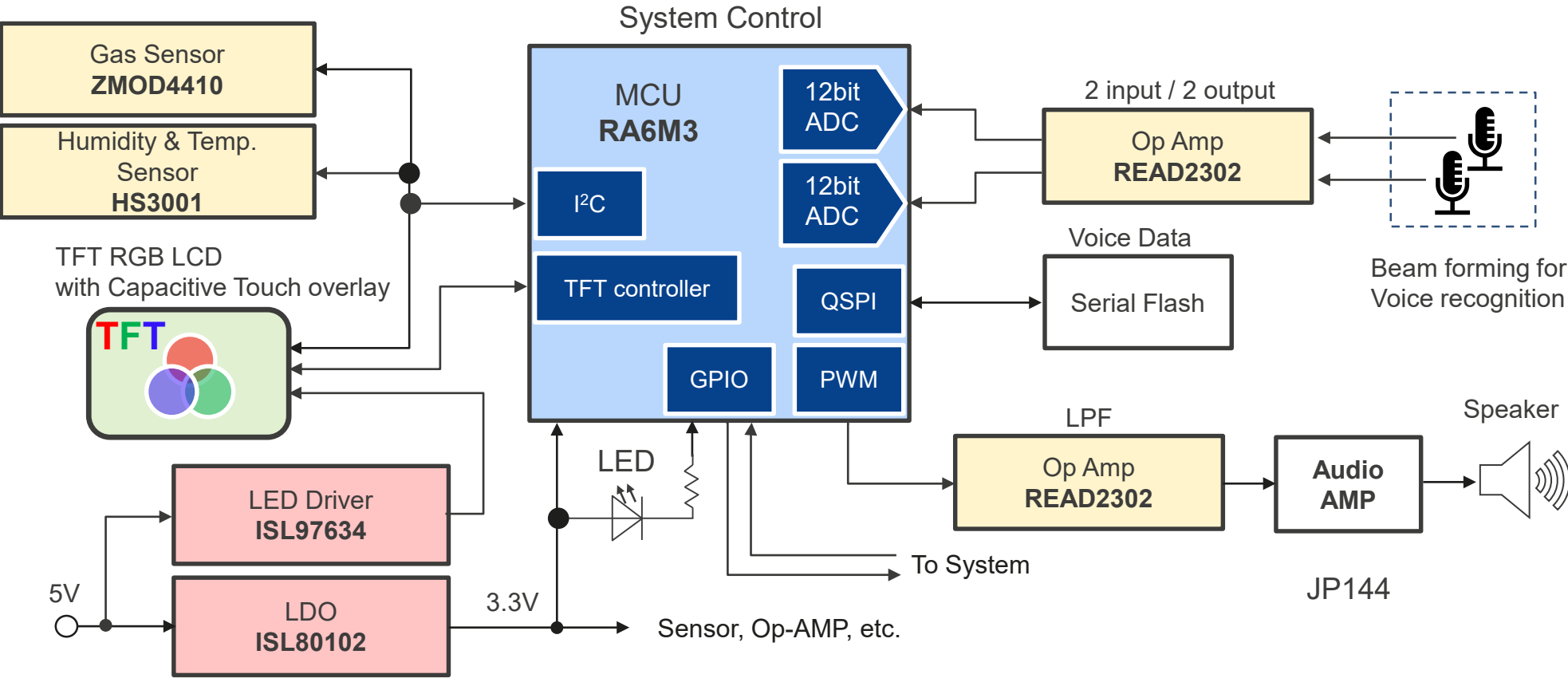
Smart Kitchen Appliance HMI

Device Category	Orderable P/N	Key Features
MCU	RA6M3	Ultra-low power 120MHz Arm® Cortex ®-M4 core. Fully featured for applications that need HMI/control/security/graphical and capacitive touch.
Power	ISL80102	High performance 2A/3A LDO. Low voltage, high-current with output voltages of 0.8V to 5.5V on the adjustable $V_{OUT.}$
	ISL97634	LED driver with wide PWM dimming range. Highly efficient and integrated PWM boost LED driver up to 26V output.
Analog	ZMOD4410	Indoor Air Quality sensor platform. TVOC sensor for Indoor Air Quality applications.
	HS3001	Relative humidity and temperature sensor. High accuracy humidity and temperature measurement for environmental monitoring.
	READ2302	6MHz GBW dual op amp. High drivability & high slew rate, input output full range.

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RA6M3 – Ultra-Low Power 120-MHz Arm® Cortex®- M4 Core

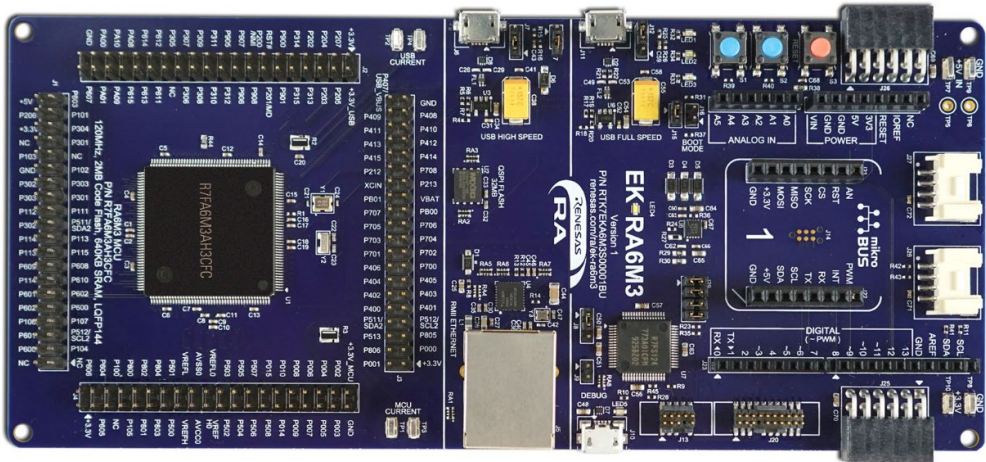## Fully Featured for Applications That Need HMI/Control/Security/Graphical and Capacitive Touch

High Performance
- 120MHz Arm® Cortex®-M4 CPU

Highly Integrated Capabilities
- 1MB-2MB Flash Memory and 640kB SRAM
- 128-bit unique ID
- 12-Bit ADC (x2)
- 12-Bit DAC

Communication Interfaces
- USB 2.0 (Full Speed/ High Speed)
- Ethernet Controller with DMA
- SCI x10/SPIx2/IICx3

HMI Interface
- Capacitive Touch Sensing Unit (18ch.)
- Graphics LCD Controller

Security and Encryption
- AES128/192/256, 3DES/ARC4, SHA1/SHA224/SHA256/MD5, GHASH, RSA/DSA/ECC
- True Random Number Generator (TRNG)

FLASH / RAM	2MB / 640kB	RA6M3	RA6M3	RA6M3	RA6M3	RA6M3
	1MB / 640kB	RA6M3	RA6M3	RA6M3	RA6M3	RA6M3
Pin Count Package Size Pitch		100pin LQFP 14x14 0.5mm	144pin LQFP 20x20 0.5mm	145pin LGA 7x7 0.5mm	176pin LQFP 24x24 0.5mm	176pin BGA 13x13 0.8mm

Flash/ RAM/ Package Table

RTK7EKA6M3S00001BU

Part #	Flash Memory	RAM	Temp	Package
R7FA6M3AH3CFC#AA0	2MB	640KB	40～105℃	176 LQFP
R7FA6M3AF3CFC#AA0	1MB	640KB	40～105℃	176 LQFP

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ISL80102/3 – High Performance 2A/3A LDO

Low Voltage, High-Current with Output Voltages of 0.8V to 5.5V on the Adjustable V_{OUT}
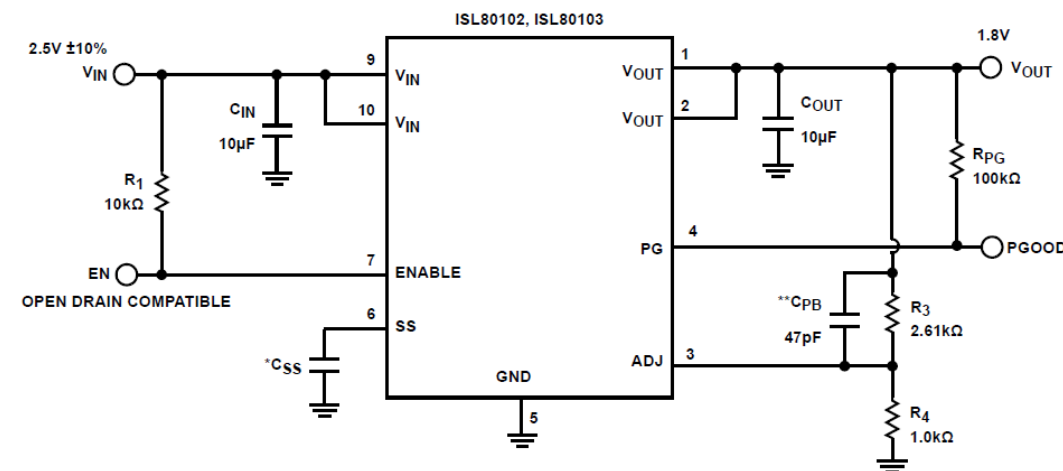
Stable Output Voltage

- ±1.8% Adjustable V_{OUT} accuracy guaranteed over line, load and T_J = -40-125 °C
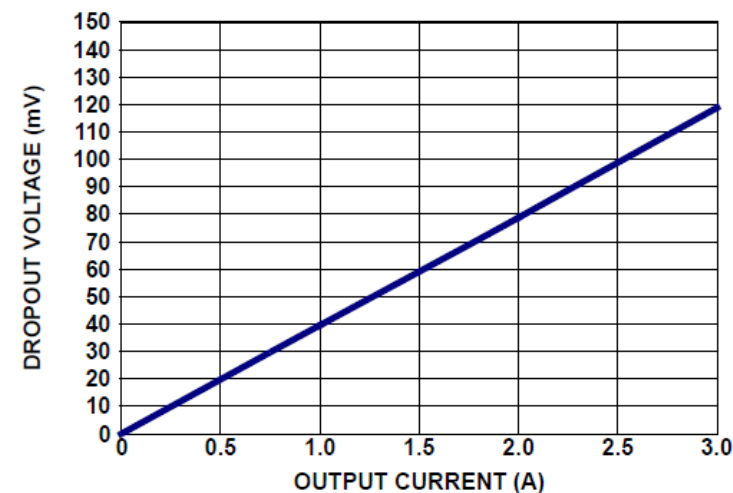- Stable with ceramic capacitors, up to 3A output current

High Performance

- Very low 120mV dropout voltage at 3A
- Very fast transient response
- 49uV$_{RMS}$ output noise, excellent 62dB PSRR

Excellent Safety

- Power good output
- Adjustable inrush current limiting
- Short-circuit and over temperature protection

Part #	V_{OUT}	I_{OUT}	Temp. Range(℃)	Package
ISL80102IRAJZ	ADJ	2A	-40 to 125	10Ld 3x3 DFN
ISL80103IRAJZ	ADJ	3A	-40 to 125	10Ld 3x3 DFN

ISL80102, ISL80103

Typical Application Circuit for Adjustable Output Voltage

Dropout Voltage vs Output Current

ISL97634 – LED Driver with Wide PWM Dimming Range
## High Efficient and Integrated PWM Boost LED Driver Up to 26V Output

Simple and Flexible Use

- Drives up to 26V output
- Integrated over-voltage protection (OVP) of 14V, 18V, and 26V for various number of LEDs in series
- PWM dimming control from DC to 32kHz
- 2.4V to 5.5V input

High Efficiency and Integrated Features

- 8 Ld 2mmx2mm DFN
- 85% efficiency
- 1µA shutdown current
- Integrated schottky diode
- Output disconnect switch

Part #	OVP Options(V)	V_{IN} Range(V)	Temp.(℃)	Package
ISL97634IRT14Z-T	14	2.4 to 5.5	-40 to 85	8 Ld 2x3 TDFN
ISL97634IRT18Z-T	18	2.4 to 5.5	-40 to 85	8 Ld 2x3 TDFN
SL97634IRT26Z-T	26	2.4 to 5.5	-40 to 85	8 Ld 2x3 TDFN
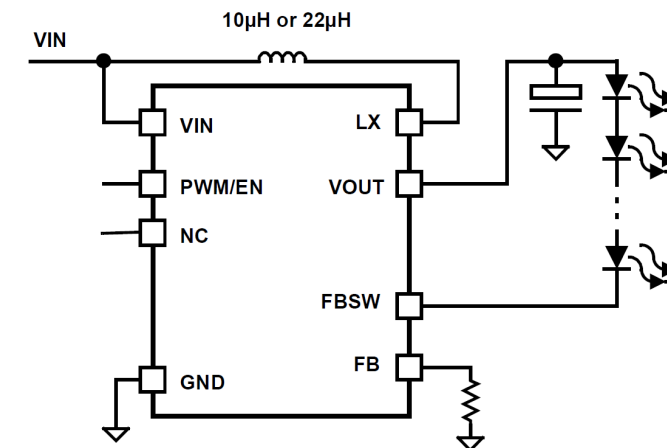
Typical Application Circuit
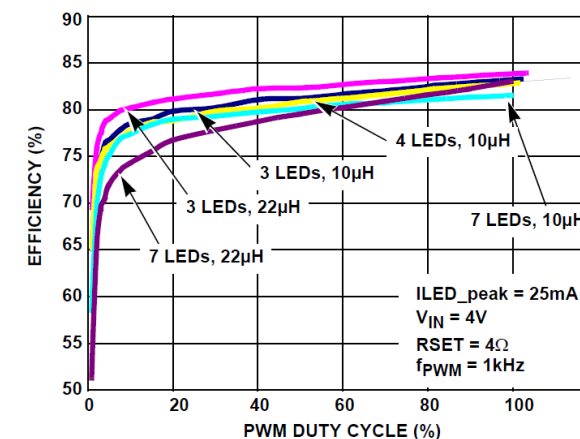
FIGURE 2. EFFICIENCY vs PWM DUTY CYCLE

Efficiency vs PWM Duty Cycle

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ZMOD4410 – Indoor Air Quality Sensor Platform

TVOC Sensor for Indoor Air Quality Applications

Flexible Measure Target:

- Measurement of total organic compounds (TVOC)
- Concentrations and indoor air quality (IAQ)
- Module algorithm estimates carbon dioxide level (eCO$_2$)
- Algorithm to set a control signal to trigger an external action based on IAQ and odor change
- Configurable alarm/interrupt output with static and adaptive Levels

Low Power

- Very low average power consumption down to 1mW
- Excellent for low-voltage and low-power battery applications

Easy to Use

- ZMOD4410 Evaluation Kit
- Manuals, application notes, blog, and white papers
- Instructional videos
- Programming libraries, example codes, and algorithm support to optimize performance
- Third-party certification for compliance with well-accepted international IAQ standards

Part #	Operation Condition	Package
ZMOD4410AI1V ZMOD4410AI1R	1.7-3.6V -40° to +65° Est. CO2 400-5000ppm Ethanol in air 0-1000ppm	3.0 × 3.0 × 0.7mm, 12-LGA
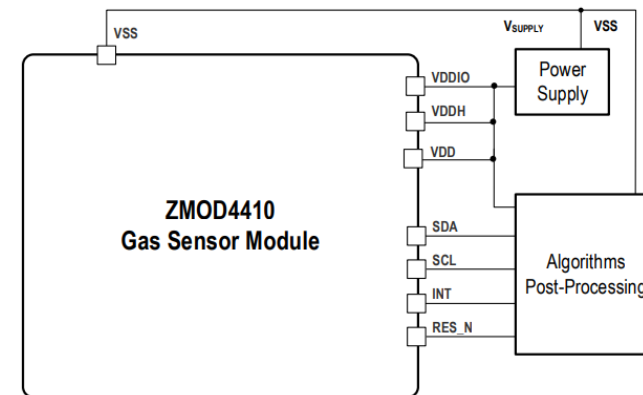
ZMOD4410 typical application
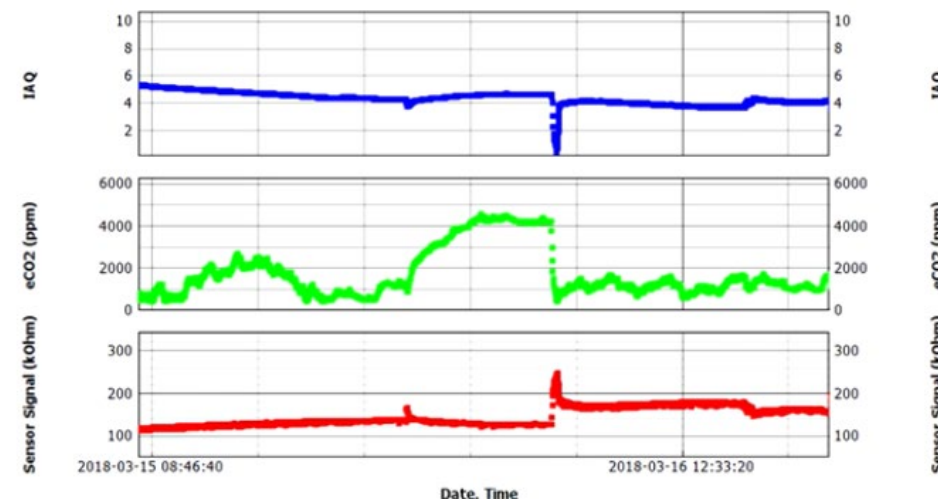
Measuring IAQ and Est CO$_2$ level with ZMOD4410

HS300X – Relative Humidity and Temperature Sensor

High Accuracy Humidity and Temperature Measurement for Environmental Monitoring

High Accuracy

- ±1.5%RH accuracy (HS3001)
- ±0.2°C temperature accuracy (HS3001, HS3002)

Excellent Stability

- 0.1%RH per year drift
- MEMS silicon-carbide sensor technology

Fast Response

- Less than 4 seconds humidity response, in still air
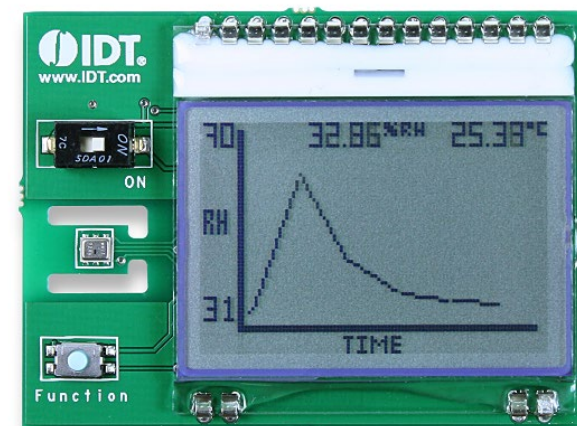- Less than 2 seconds temperature response

Extended Supply Voltage

- 2.3V to 5.5V, 24.4µA at 3.3V (one RH+Temp per second)
- 1.8V custom order

Part #	Feature	Package
HS3001	±1.5%RH	3×2.41×0.8 LGA
HS3002	±1.8%RH	3×2.41×0.8 LGA
HS3003	±2.8%RH	3×2.41×0.8 LGA
HS3004	±3.8%RH	3×2.41×0.8 LGA

R_P = Pull-up resistor (2.2kΩ typical)
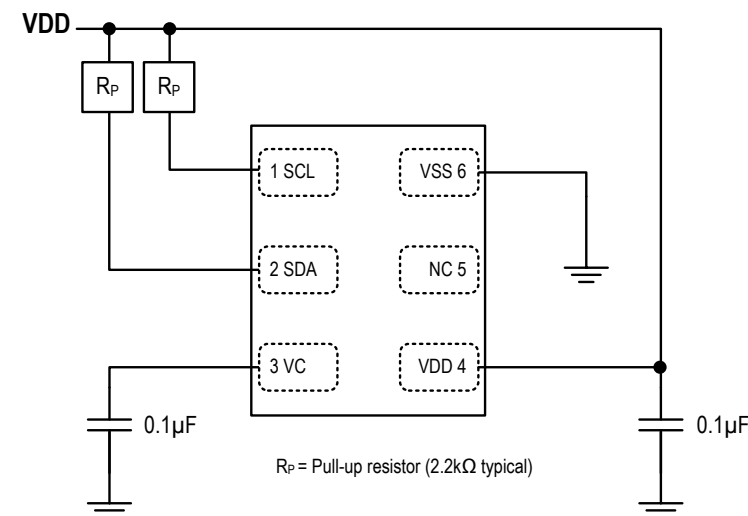
Typical Operating Circuit

SDAH02 Evaluation Kit

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READ2302G – 6MHz GBW Dual Op Amp
High Drivability & High Slew Rate, Input Output Full Range

High Performance

- High slew rate SR = 8V/μs Typ.
- 6MHz GBW
- Low input offset voltage VIO ≤ ±6.0mV
- Low input bias current IB ≤ (1pA).
- Supply current (per channel) IDD = 0.75mA Typ.

Easy to Use

- Low Voltage Single Supply : VDD = 2.5V to 5.5V
- Output Full Range : VOUT : VSS+0.1V to VDD-0.1V(@Io=5mA)
- Wide Operating temperature : -40°C to +105°C

Compact Size

- Ultra-small 8 pins TSSOP packages
- Dual channel

Part #	Product type quality level	Package
READ2302GSP	High slew rate with Normal quality level	TSSOP8

Pin Arrangement

A_V, φ vs. f

Voltage Gain, Phase Margin vs Frequency

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