Connect with IoT

Speech Synthesis LSI Series

Ver.3.1

ROHM GROUP
LAPIS
TECHNOLOGY

No.1*
Japanese domestic share
Proven customer
support provided
for over 40 years

LAPIS Technology Co.,Ltd.

*LAPIS Technology study

LAPIS Technology
Speech Synthesis LSI series

In addition to leveraging sound technologies ranging from sound compression/decompression and acoustic processing to digital filters and amps, LAPIS Technology's wide lineup of speech synthesis LSIs integrate peripheral technologies such as P2ROM™ and flash memory.

The broad portfolio includes series with built-in ROM ideal for voice guidance/alarm/message/sound playback along with high reliability types optimized for automotive applications.

Our focus on 'enhanced sound quality' has been well-received by customers for many years.

We deliver solutions and support that meet customer demands while providing added value.

No.1*
Japanese domestic share

Proven customer support provided for over 40 years

Product development that takes into account the needs of the times

Wide lineup ranges from simple to high performance types

Qualified under the AEC-Q100 automotive standard

Memory

ADPCM2
HQ-ADPCM
Synthesis

Amp

Built-in long playback memory

Built-in short playback memory

Supports external memory

LAPIS Technology speech synthesis LSIs
allow users to immediately add high quality voice functionality
to virtually any application

LAPIS Technology Speech Synthesis LSIs feature: — Simple operation

◆Enables easy sound playback by sending a simple command from the MCU

LAPIS Technology Speech Synthesis LSIs feature: — Multiple functions

◆Multiple built-in sound-related functions. Equipped with fail-safe functions including playback sound detection for automotive use
- Simultaneous multi-channel playback function
- ROM editing function and more...
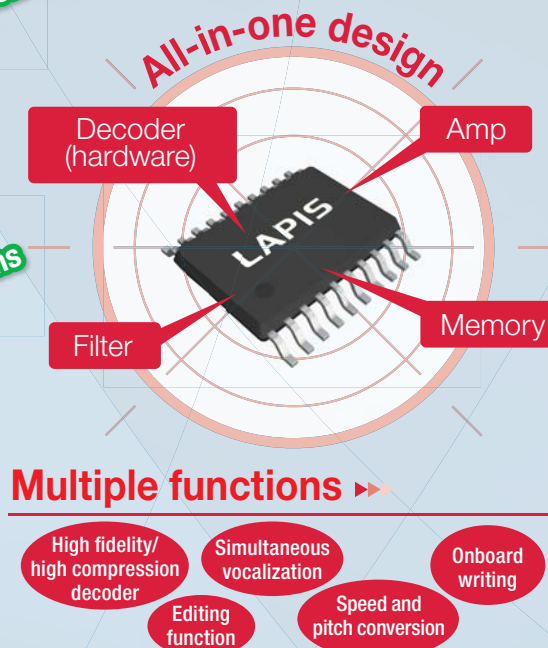
LAPIS Technology Speech Synthesis LSIs feature: — High-quality sound

◆48kHz Max sampling frequency (middleware typically from 8kHz to 12kHz)
◆Built-in high performance DAC and filter

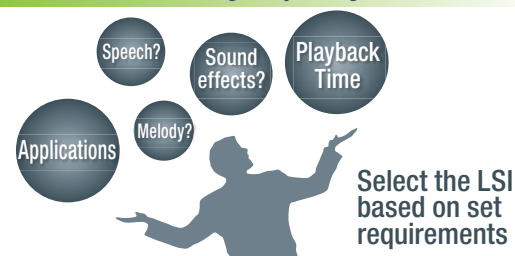### LAPIS Technology Speech Synthesis LSIs feature: — Greater space savings

◆Highly integrated design from speech synthesis engine to speaker amp reduces the number of external parts
◆Fewer external parts reduces the failure rate

All-in-one design

- Decoder (hardware)
- Amp
- Filter
- Memory

LAPIS

Multiple functions ▶▶

- High fidelity/ high compression decoder
- Simultaneous vocalization
- Editing function
- Speed and pitch conversion
- Onboard writing

Comprehensive support from LSI selection to mass production
Also supports voice creation (fee may be required)

Customer Tasks

STEP 1. Select the LSI series/ Memory capacity

- Speech?
- Sound effects?
- Playback Time
- Applications
- Melody?

Select the LSI based on set requirements

STEP 2. Create a phrase list

Address	Speech
1	Good Morning
2	Good Afternoon
3	♪♪

LAPIS Technology and/or Customer Tasks

STEP 3. Create original sound

- Studio recording
- Melody/sound effect creation
- Existing source

STEP 4. Voice analysis and editing

- Editing
- Volume adjustment
- Mixing
- Equalizing

STEP 5. Complete the ROM data
Write before shipment

Additional recording (in some cases)

Additional recording (in some cases)

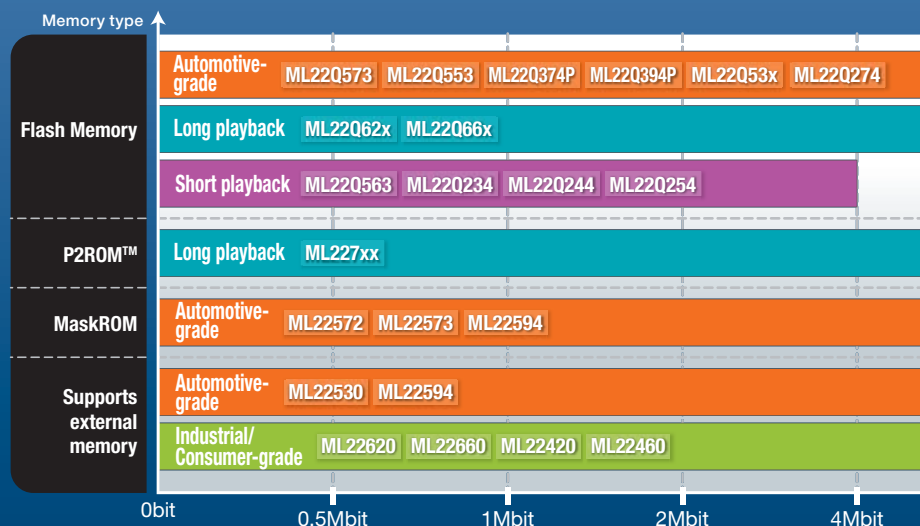Demo/correction

For a variety of applications

LAPIS Technology
Speech Synthesis LSI/Speech MCU series Lineup

1M	2M	4M	8M

Automotive-grade

·Vehicle proximity notification

Buuuu-n

·Park assist system
·Startup sounds
·Alarm sounds (interior/exterior)
·Operating sounds

Startup sounds
Blinkers
Door open alert
Seatbelt warning

Automotive-grade
Speech Synthesis LSIs

Ideal for generating voice guidance and warning sounds in vehicles ranging from tens of seconds to minutes
Two types available: Mask ROM for mass production and rewritable Flash memory

Other

·Remote control operating sounds
·Toys, alarm clocks

Beep beep beep

Alarm-related

·Residential fire alarms
·Gas alarms
·Motion sensors

Beep beep, there's a fire

The fire alarm has been activated

Consumer Electronics

·Rice Cookers
·Home bakeries
·Microwave ovens

Baking completed

Reheating started

Consumer Electronics

·Rice Cookers
·AC
·Hot water remote control

Cooking completed

Short playback
Speech Synthesis LSIs

Ideal for generating sound effects and warning sounds ranging from tens of seconds to minutes
Two types available: Mask ROM for mass production and rewritable Flash memory

Speech MCUs

Enables playback sounds on a single chip
Ideal for generating sound effects and warning sounds for tens of seconds
Offered with built-in rewritable Flash memory

There's an intruder

Alarm-related

·Home security
·Disaster prevention systems
·Earthquake alarms

Heating has started

Cooking completed

Consumer Electronics

·Washer and Driers
·Rice Cookers
·Water heaters
·Intercom systems
·Induction cooktops
·AC
·Microwave ovens

Dehumidification has started

Reheating started

The set temperature has been reached
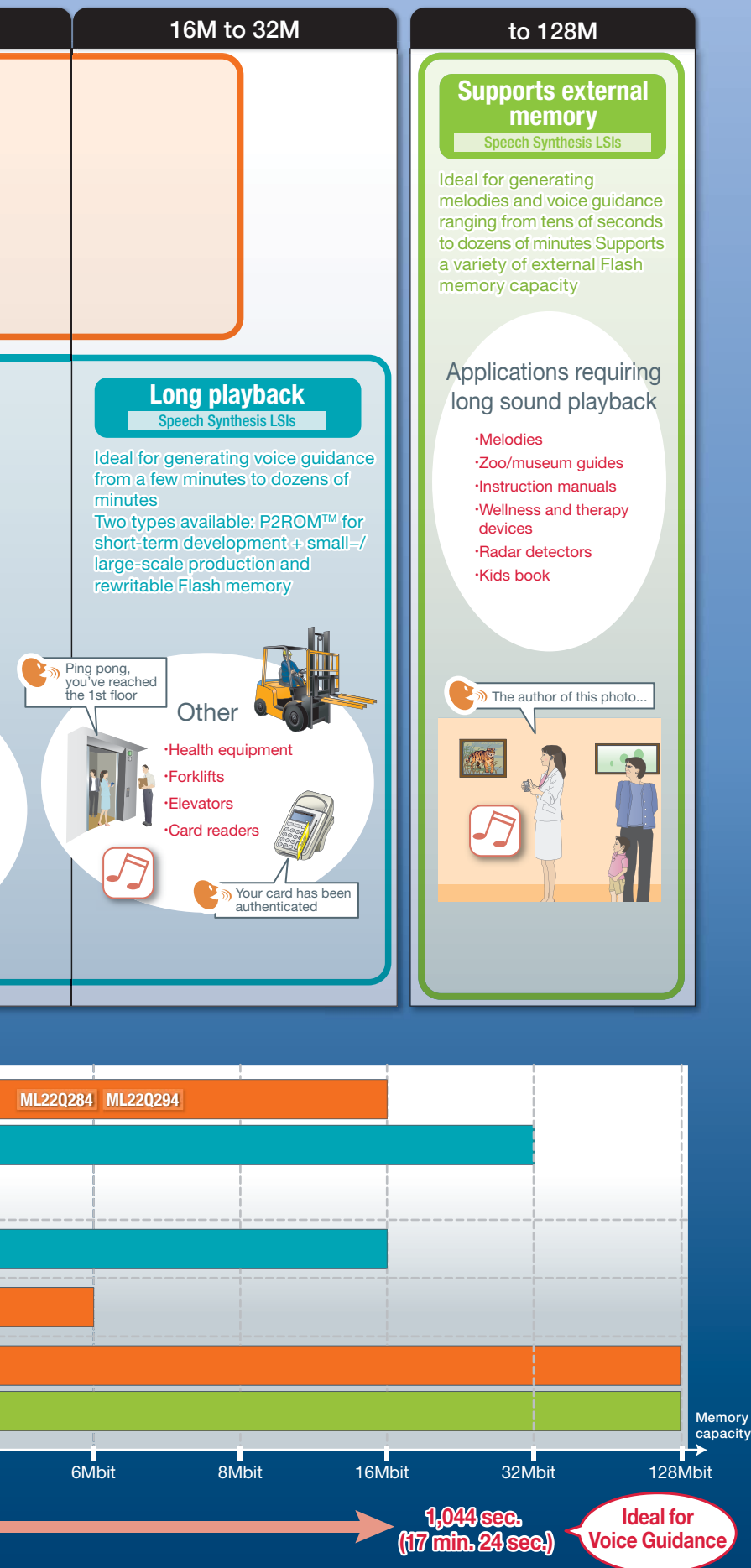
Hot water supply has started

Users can select the ideal product from a broad lineup based on playback time, voice type, and usage, while meeting the demands for shorter development periods and low-volume multi-purpose applications as well as long voice guidance with sound effects. In addition, ROHM offers automotive-grade speech synthesis LSIs with built-in speaker amp that suppresses heat generation capable of high temperature operation up to +105°C, ensuring worry-free operation even for customers requiring high automotive reliability.

Built-in 32Mbit (Max) ROM

Broad lineup

+105°C operation guaranteed (Automotive-grade)

Memory type

		0.5Mbit	1Mbit	2Mbit	4Mbit
Flash Memory	Automotive-grade	ML22Q573 ML22Q553 ML22Q374P ML22Q394P ML22Q53x ML22Q274			
	Long playback	ML22Q62x ML22Q66x			
	Short playback	ML22Q563 ML22Q234 ML22Q244 ML22Q254			
P2ROM™	Long playback	ML227xx			
MaskROM	Automotive-grade	ML22572 ML22573 ML22594			
Supports external memory	Automotive-grade	ML22530 ML22594			
	Industrial/Consumer-grade	ML22620 ML22660 ML22420 ML22460			

0bit

Ideal for sound effects

27 sec.

Playback Time

| 16M to 32M | to 128M |

Supports external memory
Speech Synthesis LSIs

Ideal for generating melodies and voice guidance ranging from tens of seconds to dozens of minutes Supports a variety of external Flash memory capacity

Long playback
Speech Synthesis LSIs

Ideal for generating voice guidance from a few minutes to dozens of minutes
Two types available: P2ROM™ for short-term development + small–/large-scale production and rewritable Flash memory

Applications requiring long sound playback

·Melodies
·Zoo/museum guides
·Instruction manuals
·Wellness and therapy devices
·Radar detectors
·Kids book

Ping pong, you've reached the 1st floor

Other

·Health equipment
·Forklifts
·Elevators
·Card readers

Your card has been authenticated

The author of this photo...

ML22Q284 ML22Q294

6Mbit   8Mbit   16Mbit   32Mbit   128Mbit

Memory capacity

1,044 sec.
(17 min. 24 sec.)

Ideal for Voice Guidance

INDEX

Automotive-grade Speech Synthesis LSIs

Ideal for long sound playback in automotive applications
ML2253x series

The ML2253x series are 4 channels mixing speech synthesis LSIs that support automotive quality and have a serial audio interface and built in flash memory for sound code data.

Features include HQ-ADPCM, 16bit D/A converter, and low-pass filter for achieving high sound quality, along with an integrated 1.0W monaural speaker amp that enables direct speaker drive.

A failure detection function is also built in capable of detecting malfunctions.

All functions necessary for sound output are integrated on a single chip, making it possible to easily add voice functionality by simply adding this LSI.

Flash Memory	Memory capacity
ML22Q532	2Mbit
ML22Q533	4Mbit
ML22Q535	16Mbit
ML22530	128Mbit*

*The maximum external memory that can be connected (there is no internal memory)

ML2253x series

ML22Q535(16Mbit)
ML22Q533(4Mbit)
ML22Q532(2Mbit)
ML22530 (External memory)

Improved functionality and performance

Enhanced failure detection
▶ Integrated failure detection functions (Playback/Clock abnormality detection)
▶ Built-in fail-safe functions (Short-circuit, high temp. error, command transfer error detection)
▶ Various additional I/F(i.e. Serial audio I²S)
▶ AEC-Q100 qualified

ML225xx series

ML22594(6Mbit)
ML22Q553(4Mbit)
ML22(Q)573(4Mbit)
ML22572(2Mbit)

High performance・High fidelity
▶ Guaranteed +105°C operation
▶ High-quality sound/high compression algorithms
▶ Built-in fail-safe functions (High temp. error, command transfer error detection)
▶ Integrated 1.0W speaker amp (Class AB)

to 2017	2018	2019	future from 2020

Parameter	ML22Q573	ML22Q53x/ML22530	Advantages of ROHM's
Audio Interface	None	Serial Audio Interface	Supports serial audio interface(I2S) input
Flash memory rewrite from MCU	None	Available	Rewrite possible after shipment
Flash memory capacity ( ) indicates external memory	4Mbit	16/4/2Mbit	Expanded memory variety
Internal speaker amp	1W Class AB (8Ω, DVDD=5V)	1W Class AB (8Ω, DVDD=5V)	Provides Class AB operation without concern for radiation noise
Simultaneous sound generation (mixing) function	4 channels	4 channels	Enables 4 channels simultaneous playback of in-vehicle notification sounds
Playback abnormality detection	None	Available	LSI failure detection function added
Speaker disconnect/ Short-circuit detection	Short-circuit detection only	Speaker disconnect/ Short-circuit detection included	Enhanced functionality
Operating Temperature	−40°C to +105°C	−40°C to +105°C	Supports high temperature operation: +105°C

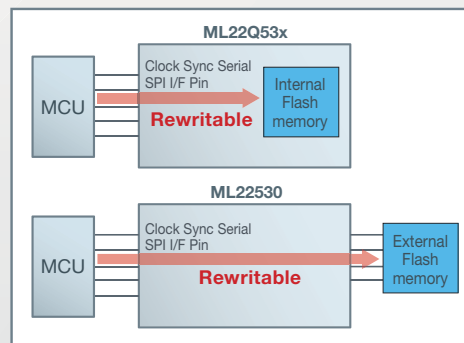## Enables rewriting to internal/external Flash memory from the MCU via SPI I/F

ML22Q53x can be rewritten the internal flash memory via the clock synchronous serial interface. ML22530 can be rewritten the external flash memory via the clock synchronous serial interfacace. In addition, sound code data can be rewritten in the field even after product shipment.

Rewriting sound code data

ML22Q53x

MCU — Clock Sync Serial SPI I/F Pin — **Rewritable** → Internal Flash memory

ML22530

MCU — Clock Sync Serial SPI I/F Pin — **Rewritable** → External Flash memory

Estimated Rewrite Time
(When Rewriting All Data)

Memory capacity		Time (s)
		Typ
Internal Flash Memory	4Mbit	4
	16Mbit	14
External Flash Memory	128Mbit (Max)	114

Equipped with a variety of fail-safe functions

Multiple built-in fail-safe functions, such as for detecting playback abnormalities, speaker pin short-circuits, internal LSI temperature, supply voltage drops, and MCU command transfer errors, make it possible to monitor for a variety of LSI failure modes.

Playback abnormality detection

MCU — Logic → Analog → 🔊
Playback check
Provides fault detection from the input to the speaker pins
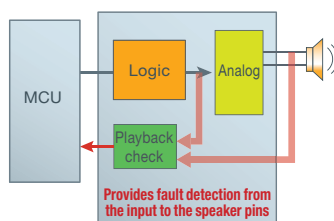
Output becomes H during abnormal playback

Short-circuit detection

Short-circuit
SP+ pin
CPU ERR output ← Short-circuit detection
SP– pin
Short-circuit
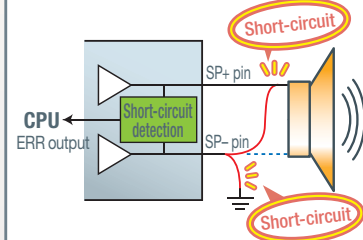
Output becomes H when ground faults occur between the SP pins (output normally L)

High temperature error detection

Speech Synthesis LSIs
Detection Circuit → CPU ERR output
Thermistor
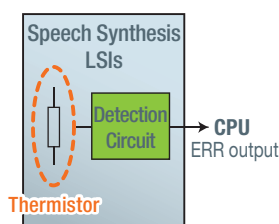
Output becomes H at high temperatures (output normally L)

Command transfer error detection

Input commands twice
Speech Synthesis LSIs
SI →
SCK → SPI I/F → Comparator → CPU ERR output
SO ←
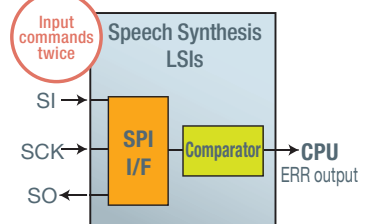
If the commands are different two times, the output becomes H (output normally L)

Automotive-grade Speech Synthesis LSIs

Ideal for short sound playback in automotive applications

☆ML222xx series　New ML223xx series　ML225xx series

The ML222xx, ML223xx, and ML225xx series integrate a speaker amp. and feature a guaranteed operating temperature up to +105°C.
At the same time, the ML225xx series is equipped with multiple fail-safe functions required for automotive applications, including detecting the internal IC temperature, supply voltage drops, and MCU command transfer errors.

MaskROM	Flash Memory	CPU I/F	Memory capacity
–	☆ML22Q274	Clock Sync Serial	692Kbit
	☆ML22Q284	Standalone	
	☆ML22Q294	I²C	
	New ML22Q374P	Clock Sync Serial	
	New ML22Q394P	I²C	
ML22572	–	Clock Sync Serial	2Mbit
ML22573	ML22Q573		4Mbit
–	ML22Q553		
ML22594	–		6Mbit*

Pin compatibility (ML22572 ↕ ML22573 → ML22Q573)

*Integrated 6Mbit allows external memory to be connected
☆: Under Development

Feature 1

Standalone type available

Easy sound playback is possible without MCU control. External control is fixed to the terminal, eliminating the need to develop software for audio playback.

Applicable Models: ML22Q284

H or L
S/W
Speech Synthesis LSI
Speaker
No MCU required
MCU
Command
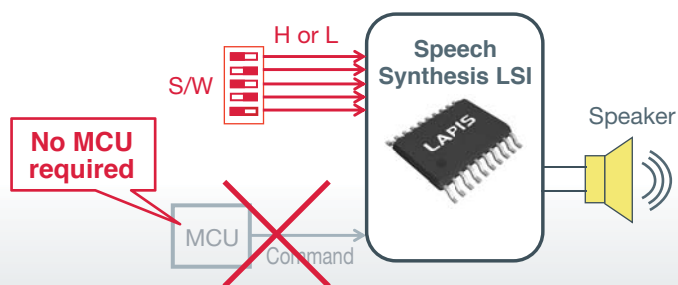
Feature 2

Built-in speaker amp ensures stable operation at +105°C

Automotive-grade speech synthesis LSIs are offered featuring a guaranteed operating temperature range of –40°C to +105°C. Integrated memory and speaker amp, together with support for high temperature operation, ensure worry-free use in automotive applications.
The exposed backside die pad enables heat dissipation through the substrate, making it possible to suppress temperature rise within the LSI (including the speaker amp) and ensure stable performance even at an ambient temperature of +105°C.

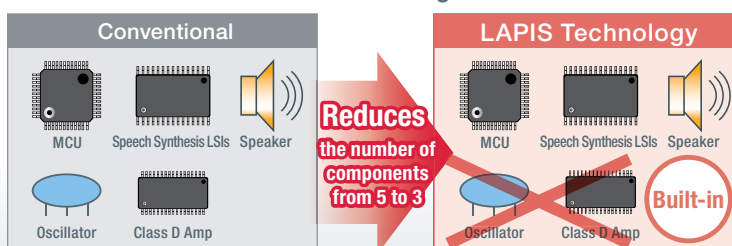Backside die pad featuring superior heat dissipation ensures high temperature operation

Guaranteed +105°C operating temperature
Terminal
Mold Resin
Device Chip
Frame
Solder
Backside Die Bond
Heat dissipation
Thermal dissipation to the substrate suppresses temperature rise

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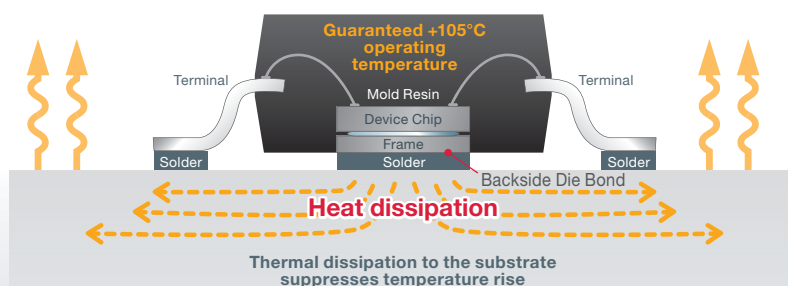
Feature 3

Integrated oscillator and Class D amp reduces component count

The built-in high accuracy 4.096MHz±1.5% (–10°C to +50°C) oscillator and Class D amp require almost no peripheral parts and enable sound playback by simply connecting to a speaker. In addition, the compact package reduces mounting area.
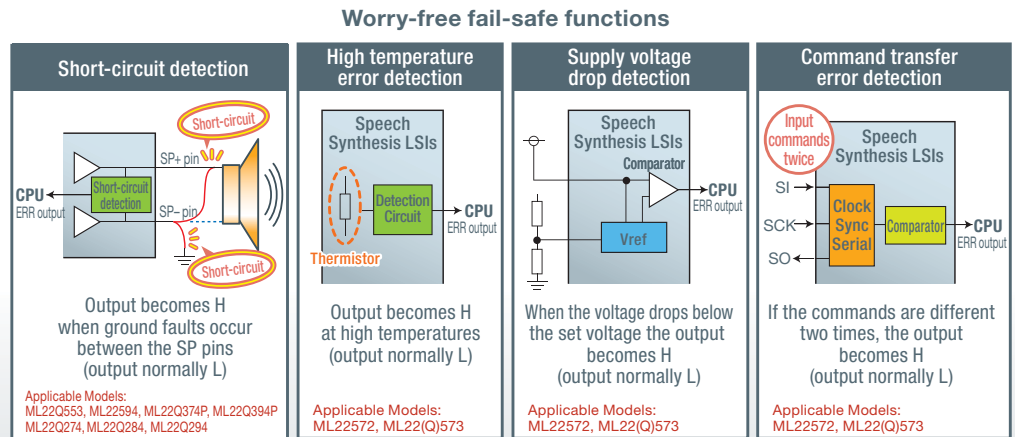

Reduced mounting area

Conventional
MCU　Speech Synthesis LSIs　Speaker
Oscillator　Class D Amp

Reduces the number of components from 5 to 3

LAPIS Technology
MCU　Speech Synthesis LSIs　Speaker
Oscillator　Class D Amp
Built-in

Worry-free fail-safe functions

Fail-safe functions ensure high system reliability

4 built-in error flags for detecting speaker pin short-circuits, internal LSI temperature, supply voltage drops, and MCU command transfer errors make it possible to notify the control MCU of abnormalities via the ERR pin.
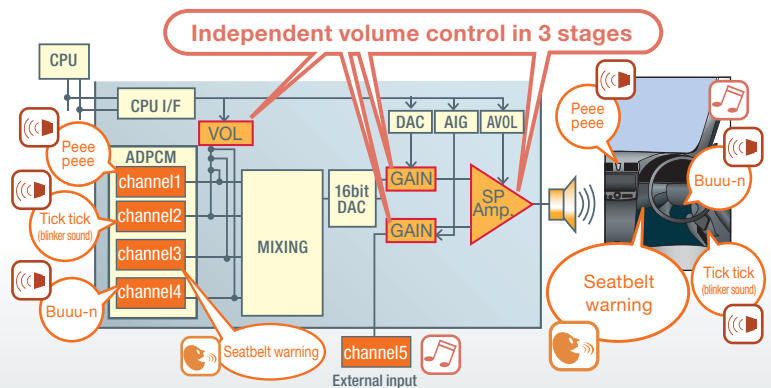
Short-circuit detection	High temperature error detection	Supply voltage drop detection	Command transfer error detection

Short-circuit detection

Output becomes H when ground faults occur between the SP pins (output normally L)

Applicable Models:
ML22Q553, ML22594, ML22Q374P, ML22Q394P
ML22Q274, ML22Q284, ML22Q294

High temperature error detection

Output becomes H at high temperatures (output normally L)

Applicable Models:
ML22572, ML22(Q)573

Supply voltage drop detection

When the voltage drops below the set voltage the output becomes H (output normally L)

Applicable Models:
ML22572, ML22(Q)573

Command transfer error detection

If the commands are different two times, the output becomes H (output normally L)

Applicable Models:
ML22572, ML22(Q)573

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5 channels mixing and independent volume adjustment

Enables simultaneous playback of up to 5 channels (4 channels sound playback + 1 channel external input). What's more, the volume of each channel can be independently adjusted, providing greater ease-of-use.

The ML22572, ML22(Q)573, ML22Q553, and ML22594 integrate a mixing function that enables simultaneous playback of 4 internal and 1 external channels.
This makes it possible to play multiple sound effects, sound, and external analog input at the same time. The volume of each channel can be independently adjusted. And users can play mixed sounds at a certain volume without changing the volume of the original sound.

Applicable Models: ML22572, ML22（Q)573, ML22Q553, ML22594

Independent volume control in 3 stages

Onboard writing for each customer based on destination

Flash memory types support onboard writing

All Flash memory types also support onboard writing. This allows sound code data to be uploaded while mounted on the customer's board. Incorporating a speech synthesis LSI on board facilitates inventory management, making it possible to customize voice data according to the destination. In addition, the flexible design enables rewriting before shipment as well as sound code data to be updated at service centers.

Note: Onboard write data must be purchased from a write manufacturer

Applicable Models: ML22Q573, ML22Q553, ML22Q374P, ML22Q394P, ML22Q274, ML22Q284, ML22Q294

Inventory management of system boards by mounting speech synthesis LSIs
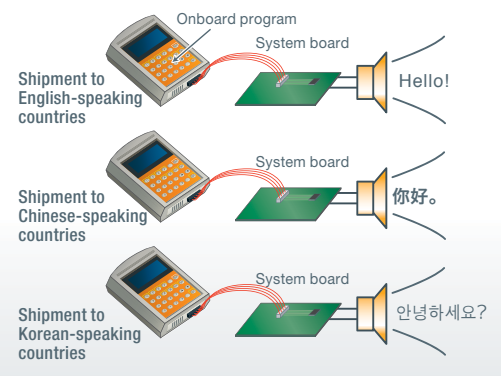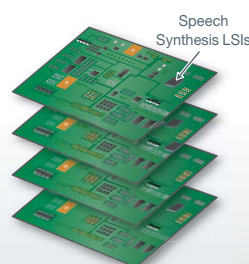
Speech Synthesis LSIs

Shipment to English-speaking countries — Hello!

Shipment to Chinese-speaking countries — 你好。

Shipment to Korean-speaking countries — 안녕하세요?

# Long playback Speech Synthesis LSIs

Ideal for long sound playback in industrial and consumer applications

ML226xx series (Built-in Flash Memory)

The ML226xx series is equipped with 4Mbit to 32Mbit Flash memory. The large memory capacity is ideal for long sound playback such as voice guidance, while Flash memory makes rewriting of sound code data possible.

Flash Memory		
I²C I/F	Serial I/F	Memory capacity
ML22Q663	ML22Q623	4Mbit
ML22Q664	ML22Q624	8Mbit
ML22Q665	ML22Q625	16Mbit
ML22Q666	ML22Q626	32Mbit

ML226xx series
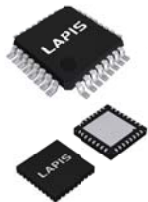
ML22Q626/666 (32Mbit)
ML22Q625/665 (16Mbit)
ML22Q624/664 (8Mbit)
ML22Q623/663 (4Mbit)

Improved functionality and performance

High performance・High fidelity
▶ Built-in Flash memory (enables writing from the MCU*¹)
▶ Built-in high fidelity, high compression algorithm (HQ-ADPCM)
▶ Internal 1.0W speaker amp (Class AB/D)
▶ Selectable internal/external oscillator
▶ Integrated fault detection functions (disconnect/short-circuit detection)
*1 Only ML22Q62x/22620 can be rewritten from MCU.

ML227xx series

ML22725/765 (16Mbit)
ML22724/764 (8Mbit)
ML22723/763 (4Mbit)

▶ P2ROM™ Built-in
▶ 4bit ADPCM2
▶ Internal 0.7W speaker amp (Class AB)
▶ Speed・pitch conversion

to 2017	2018	2019	future from 2020

Parameter	ML2272x/ML2276x	ML22Q62x/ML22Q66x	Advantages of ROHM's ML22Q62x/ML22Q66x
ROM Types	P2ROM™	Flash Memory	Enables rewriting to Flash memory from the MCU via Clock Sync Serial
Memory capacity	4/8/16Mbit	4/8/16/32Mbit	Expanded memory variety
Playback Method	4bit ADPCM2 8bit straight PCM 8bit non-linear PCM 16bit straight PCM	HQ-ADPCM 4bit ADPCM2 8bit straight PCM 8bit non-linear PCM 16bit straight PCM	Utilizes market-proven high fidelity, high compression HQ-ADPCM
Max Phrase Count	1,024	4,096	4x higher phrase count
Internal speaker amp	0.7W Class AB (8Ω, DVDD=5V)	1.0W Class D/AB (8Ω, DVDD=5V)	Built-in high efficiency Class D amp with higher Max output
Speaker disconnect/ Short-circuit detection	None	Available	Enhanced functionality
Speaker Amp Supply	Same potential as DVDD	Different potential as DVDD	3V MCU/5V speaker amp combo possible

Feature 1

The internal Flash ROM can be rewritten from the MCU via clock sync serial I/F

ML22Q62x can be rewritten the internal flash memory via the clock synchronous serial interface. In addition, sound code data can be rewritten in the field even after product shipment.

Rewriting sound code data

ML22Q62x

MCU — Clock Sync Serial I/F Pin — Rewritable → Internal Flash memory

○
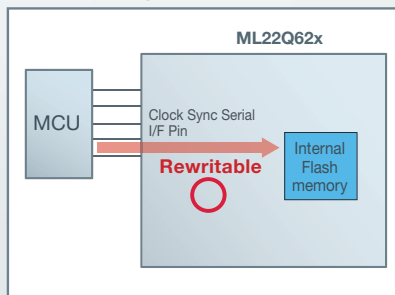
Estimated Rewrite Time
(When Rewriting All Data)

Memory capacity		Time (s)
		Typ
Internal Flash Memory	4Mbit	4
	16Mbit	14
External Flash Memory	128Mbit (Max)	114

Feature 2

Built-in high output, high efficiency Class D amp

The ML22Q62x and ML22Q66x integrate a high efficiency, high output 1W Class D amp. Class D amps provide greater efficiency and generate less heat than conventional Class AB amps.

Speaker Output Power vs. Efficiency

Efficiency (%) vs. Speaker Output Power (mW)

● Class D
● Class AB

Ave. efficiency improved **40%**
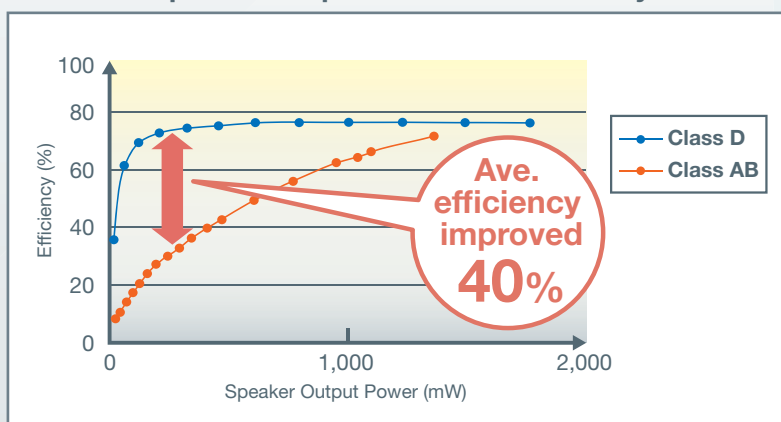
Feature 3

Built-in speaker fault detection function

Both the ML22Q62x and ML22Q66x are equipped with failure detection functions for detecting speaker disconnections and short-circuits. This allows for immediate notification of speaker failures. Speaker output is stopped when a short-circuit is detected to prevent overcurrent.

Disconnection/short-circuit detection function
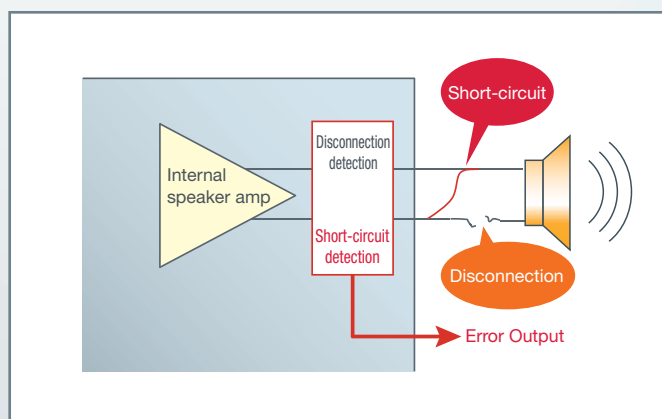
Internal speaker amp

Disconnection detection

Short-circuit detection

Short-circuit

Disconnection

Error Output

Long playback Speech Synthesis LSIs

Ideal for long sound playback in industrial and consumer applications
ML227xx series (Built-in P2ROM™)

ML227xx integrate LAPIS Technology's proprietary P2ROM™.
The LSIs can be put in standby mode during assembly, then written to with audio data after receiving an order, significantly shortening both sampling creation and mass production TAT.
Large memory capacity is ideal for long sound playback such as voice guidance.

P2ROM™		
I²C I/F	Serial I/F	Memory capacity
ML22763	ML22723	4Mbit
ML22764	ML22724	8Mbit
ML22765	ML22725	16Mbit

Feature 1

P2ROM™ achieves shorter TAT
Reduces inventory and delivery risks

ML227xx integrate LAPIS Technology's proprietary P2ROM™ memory technology for storing sound code data. This provides ROHM the capability to immediately ship prototype samples and shorten mass production TAT for customers by half. Development TAT can be shortened to around one month, about a quarter that of Mask ROM. P2ROM™ enables one-time writing in the customer's environment, making it possible to verify the sound quality on the spot without taking additional time. (Write shipment only from LAPIS Technology for mass production)

Development TAT Comparison

LSI Development

Mask ROM Products

6 to 8 weeks   6 to 8 weeks

Sound code data Creation | Prototype | Mass Production

Careful Development Mass Production

P2ROM™ Products

Sound code data Creation

Mass Production

9 to 12 weeks (shortened)

3 to 4 weeks

No prototype required

1/4 the time of Mask ROM Mass production in approx. 1 month

Shortened Development Small to Large-Scale Production

Feature 2

Built-in speech speed and pitch conversion (Sodiac) make it possible to easily achieve the playback speed and pitch suitable for user needs

Easily change voice pitch and playback using the built-in functions of the high capacity P2ROM™ speech synthesis LSI series. With conventional technology, increasing the playback speed raises the pitch, while decreasing speed lowers the pitch. Playback speed can be changed from 1/2x to 2x, and pitch can be adjusted within the range of ±20%. This is useful when wanting to change the mood of the voice or speed to make it easier to hear. At the same time it is possible to change the phrase units by command input, allowing users to freely arrange them according to application needs.

Applicable Models:
ML22763, ML22764, ML22765, ML22723, ML22724, ML22725

Creating various sounds
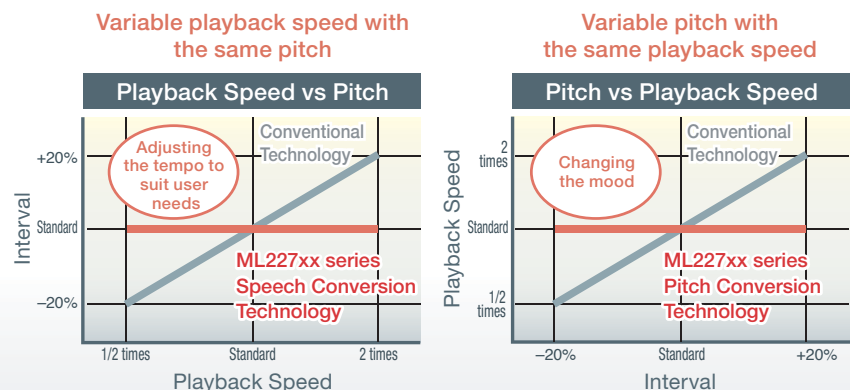
Variable playback speed with the same pitch

Playback Speed vs Pitch

Adjusting the tempo to suit user needs

Conventional Technology

Interval

+20%
Standard
−20%

1/2 times   Standard   2 times

Playback Speed

ML227xx series Speech Conversion Technology

Variable pitch with the same playback speed

Pitch vs Playback Speed

Changing the mood

Conventional Technology

Playback Speed

2 times
Standard
1/2 times

−20%   Standard   +20%

Interval

ML227xx series Pitch Conversion Technology

Short playback — Speech Synthesis LSIs

Ideal for short sound playback in industrial and consumer applications
☆ML222xx series ML225xx series

The ML222xx series is equipped with a small-capacity Flash memory.

In addition to a lineup that supports various CPU I/F, standalone models are also available that do not require an MCU, allowing users to select the ideal type based on application requirements.

MaskROM	Flash Memory	CPU I/F	Memory capacity
—	☆ML22Q234	Clock Sync Serial	672Kbit
	☆ML22Q244	Standalone	688Kbit
	☆ML22Q254	I²C	672Kbit
ML22562	—	Clock Sync Serial	2Mbit
ML22563	ML22Q563		4Mbit

Pin compatibility

☆: Under Development

Feature 1

Integrated oscillator and Class D amp reduces component count

The built-in high accuracy 4.096MHz±1.5% (–10°C to +50°C) oscillator and Class D amp require almost no peripheral parts and enable sound playback by simply connecting to a speaker. In addition, the compact package reduces mounting area.

Applicable Models: ML22Q234, ML22Q244, ML22Q254

Reduced mounting area

Conventional
MCU Speech Synthesis LSIs Speaker
Oscillator Class D Amp

LAPIS Technology
MCU Speech Synthesis LSIs Speaker
Oscillator Class D Amp Built-in

Reduces the number of components from 5 to 3
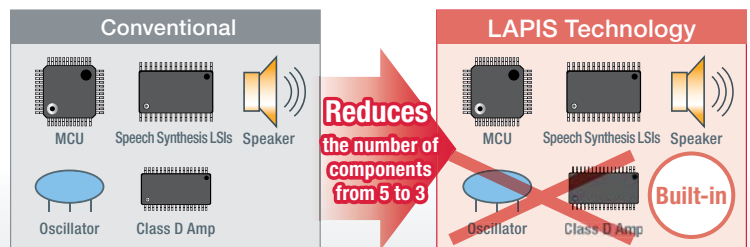
Feature 2

Integrated Class D amp ensures high efficiency output

Class D speaker amps are capable of 1.0W (Max) output, feature low heat generation even at high (sound) volumes, and minimize heat dissipation measures. In addition, efficiency is excellent at low battery power, reducing current consumption and prolonging battery life.

Applicable Models: ML22Q234, ML22Q244, ML22Q254

Speaker Output Power vs. Efficiency

Efficiency (%) — Speaker Output Power (mW)

— Class D
— Class AB

Ave. efficiency improved 40%
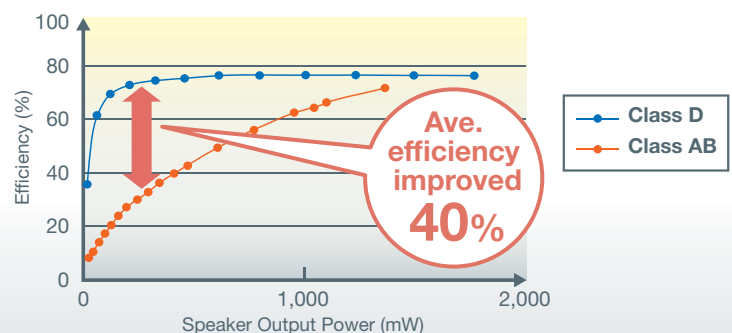
Feature 3

Built-in disconnection detection function eliminates the need to worry about speaker failure

The ML222xx series includes a disconnection detection function that can provide notification (i.e. via LED) in the event no sound is output due to disconnection between the speaker amp and speaker. Passing current between SPP and SPM enables detection through High/Low determination. This ensures worry-free operation even in the event of speaker disconnection.

Applicable Models: ML22Q234, ML22Q244, ML22Q254

Disconnection detection function

CPU I/F
Detection request
SP Amp.
SPP
SPM
Disconnection detection
Disconnection
ERR
CPU ERR output
Detect speaker failure

ERR output
| H | Disconnection |
| L | Connection |
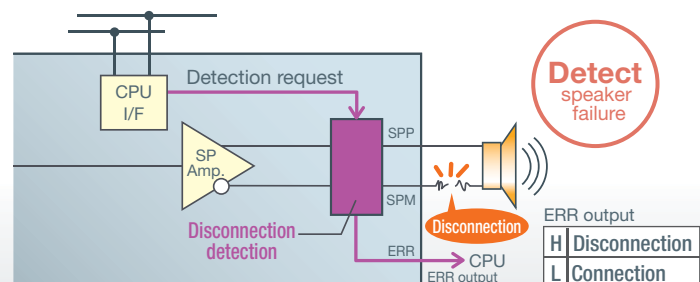
Ideal for long sound playback using external memory in industrial and consumer applications
ML226xx series ML224xx series

The ML226xx and ML224xx series support external serial memory up to 128Mbit. Ideal for long sound playback.
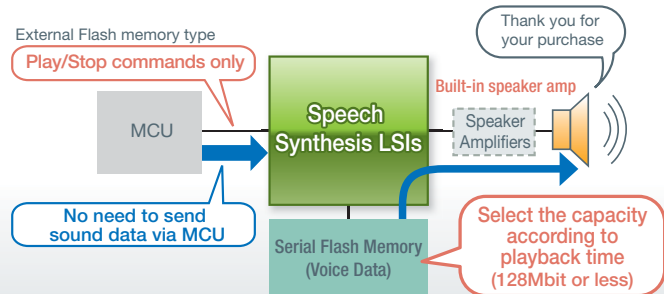
ML226xx series
ML22620
ML22660

Improved functionality and performance

High performance · High fidelity
▶ External Flash memory (rewritable from the MCU[*1])
▶ Built-in high fidelity, high compression algorithm(HQ-ADPCM)
▶ Internal 1.0W speaker amp (Class AB/Class D)
▶ Selectable internal/external oscillator
▶ Integrated fault detection function
(speaker disconnect detection, short-circuit detection)
*1: Rewriting from the MCU is possible only with the ML22620

ML224xx series
ML22420
ML22460

▶ Internal 0.7W speaker amp (Class AB)
▶ 4bit ADPCM2
▶ 4ch mixing

to 2017	2018	2019	future from 2020

Feature 1

Speech Synthesis LSIs control external memory, facilitating voice generation

Controlling external memory allows ROHM Speech Synthesis LSIs to play back audio data without placing a load on the MCU. Voice generation is easily achieved by inputting control commands of only a few bytes from an MCU.

Easily enable voice generation from external memory

External Flash memory type
Play/Stop commands only
Thank you for your purchase
MCU
Speech Synthesis LSIs
Built-in speaker amp
Speaker Amplifiers
No need to send sound data via MCU
Serial Flash Memory (Voice Data)
Select the capacity according to playback time (128Mbit or less)

Feature 2

High fidelity, high compression HQ-ADPCM makes it possible to reduce memory capacity

The ML226xx series adopts the newly developed high fidelity, high compression voice algorithm HQ-ADPCM that provides a clearer sound and richer audio range while reducing data size compared with conventional ADPCM, providing a more comfortable listening experience. For example, melodies and sound effects that are degraded with ADPCM and cannot be played with uncompressed PCM can be compressed with HQ-ADPCM, ensuring superior sound quality while reducing memory capacity. Up to 80% compression is possible vs 4bit ADPCM and 20% compared with 16bit ADPCM.

Applicable Models: ML22620, ML22660

HQ-ADPCM enables high fidelity sound compression

Image
Sound quality High
CD quality sound and data
With HQ-ADPCM
Enables compression of melodies and sound effects
HQ-ADPCM
Conventional
Required data volume Large
With Conventional ADPCM

Comparison of Data Volume Required for 30s Playback

	Conventional	HQ-ADPCM
Melody Sound Effects	16bitPCM Approx. 7.7Mbit	Approx. 3Mbit
Speech	4bitADPCM Approx. 1.9Mbit	

Reduced approx. 68%

Feature 3

Integrated Class D amp ensures high efficiency output

Class D speaker amps are capable of 1.0W (Max) output, feature low heat generation even at high (sound) volumes, and minimize heat dissipation measures. In addition, efficiency is excellent at low battery power, reducing current consumption and prolonging battery life.

Applicable Models: ML22620, ML22660

Speaker Output Power vs. Efficiency

Efficiency (%) vs Speaker Output Power (mW)
— Class D
— Class AB
Ave. efficiency improved 40%
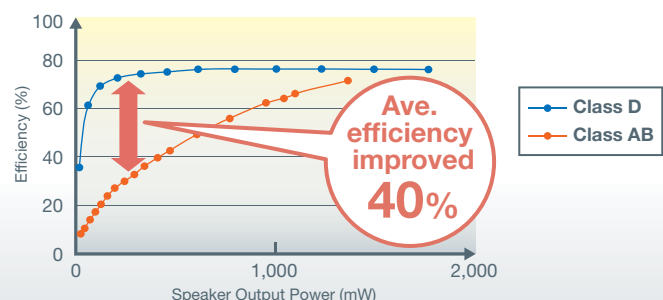
Speech MCUs

Ideal for sound playback using a single chip in industrial and consumer applications
ML610Q300 series

The ML610Q300 series of MCUs incorporate an original RISC type 8bit CPU U8 core.

Compared to conventional middleware sound playback, sound quality is superior, control is easier, and MCU performance can be maximized.

Flash Memory	Memory capacity	Sound Playback Method	Package
ML610Q304	96KByte	8bit/16bitPCM, ADPCM2	VQFN28 SSOP30 WQFN32
☆ ML610Q305		8bit/16bitPCM, ADPCM2, HQ-ADPCM	TQFP32 WQFN32
☆ ML610Q306			WQFN36

☆: Under Development

ML610Q300 series Elements   Integrating peripheral components saves space and reduces failure risk
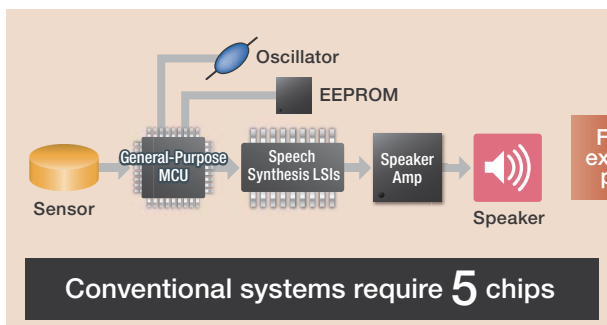
LAPIS Technology MCUs with speech output function incorporate an oscillator, EEPROM, speech synthesis LSI, speaker amp, and other peripheral components, contributing to set miniaturization.

Oscillator
EEPROM
Sensor
General-Purpose MCU
Speech Synthesis LSIs
Speaker Amp
Speaker

Fewer external parts

Sensor
Speech MCUs
Speaker

Conventional systems require 5 chips

Space-saving monolithic design reduces failure risk

Feature 1

Achieves sound output functionality on a single chip

- Low-pass filter reduces noise
- Sound algorithms
  HQ-ADPCM、4bit ADPCM2,
  8bit PCM (Non-linear/Straight), 16bit PCM (Straight)
- Equipped with 1W (Max) speaker amp at 5V
- Supply voltage range: 2.2V to 5.5V

Note : HQ-ADPCM is for ML610Q305 and ML610Q306

High performance with low power consumption

High fidelity sound playback

High output speaker amp

3V/5V compatibility
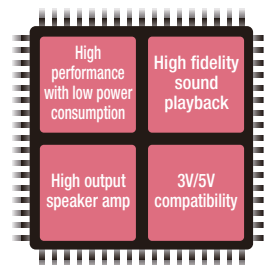
Feature 2

High performance 8bit CPU
U8 core

- Original RISC-type CPU
- 3-stage pipeline structure enables 1 instruction per clock operation
- 8bit operation features equivalent performance to 16bit MCUs

Pipeline processing

Clock
Fetch   Instruction A   Instruction B   Instruction C
Decode   Instruction A   Instruction B   Instruction C
Execute   Instruction A   Instruction B   Instruction C

1 Clock 1 Command
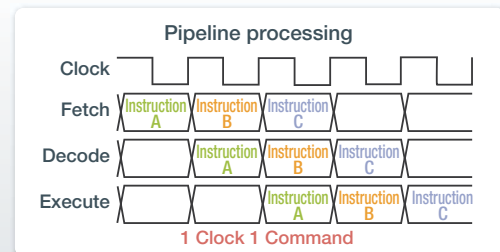
Feature 3

Easily enable sound playback

- Sound playback functionality is achieved by simply setting sound data in the register
- Integrating 4-word FIFO into the sound register makes it possible to extend the interval between sound data request interrupts

Sound Playback Conditions

16bit PCM at 16kHz

Sound data request interrupt time

250μsec

Development Support Tools

● A development tool for creating, writing, and listening to ROM data stored in LAPIS Technology's speech synthesis LSI.
● Enables a series of evaluations utilizing both hardware (SDCB2/SDCB3 and reference board) and software (Speech LSI Utility)
● Optional starter kit makes it easy to begin development using LAPIS Technology's speech MCUs

SDCK (Sound Device Control Kit) *Two types are available (SDCK, SDCK3) depending on the target IC

■ Facilitates operation from waveform editing to sound playback
■ Compatible with all models ■ Compact SDCB2/SDCB3 (70×90mm)

SDCB2/SDCB3

The SDCB2 (Sound Device Control Board 2)/SDCB3 enable writing and evaluation to OTP/Flash by connecting to a reference board equipped with LAPIS Technology's speech synthesis IC.

Target Device Reference Board (Sold separately)

Connecting to the SDCB (Sound Device Control Board) allows users to write and playback sound data. In addition, usage and evaluation is possible via MCU control by connecting to the customer's system board.

Speech LSI Utility

Speech LSI Utility is a tool for operating the SDCB. Everything from waveform editing and ROM data creation to sample writing and evaluation are enabled.

Sound Device Control Kit 'SDCK'

Sound Device Control Kit 'SDCK'	Various reference boards

Connect the reference board (sold separately) to the SDCB

Power Cable

PC   Amp   Speaker

Speech LSI Utility (CD included with SDCK)

Waveform/phrase editing preview
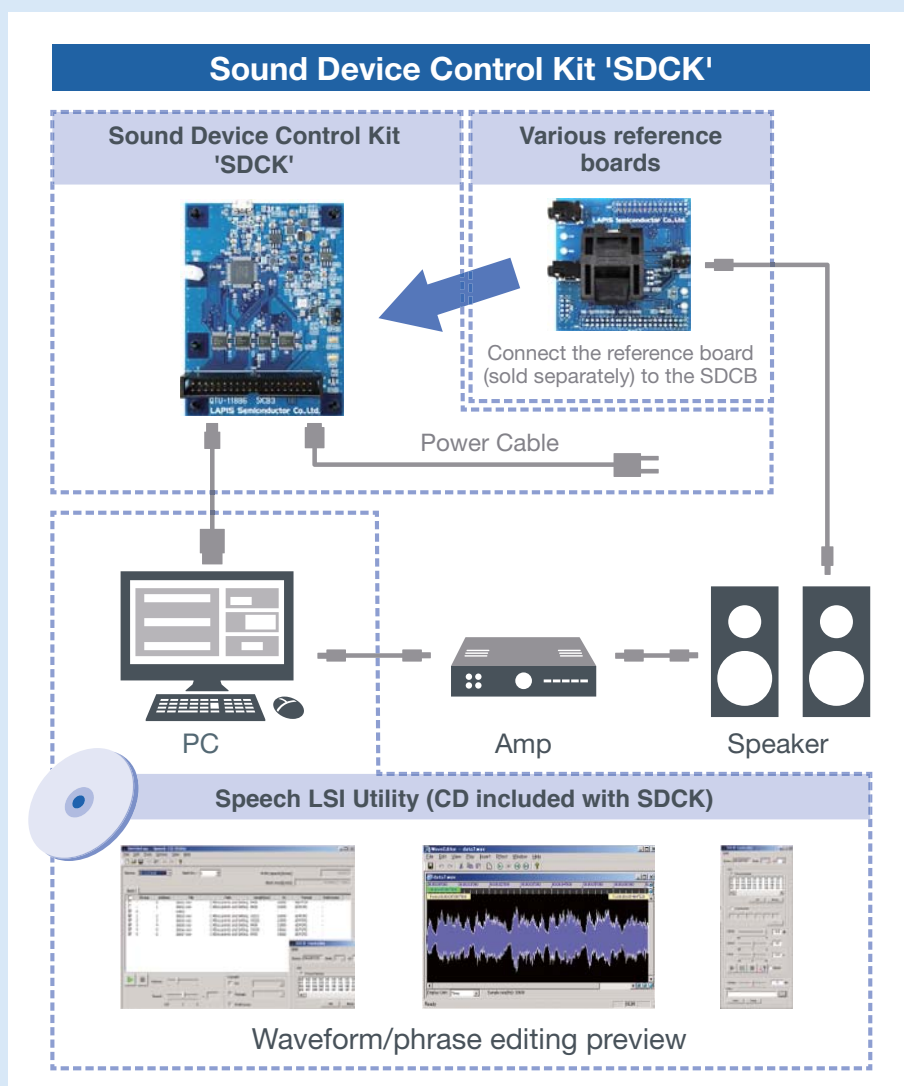
The Edit ROM function reduces memory capacity along with CPU load

The Edit ROM function allows multiple phrases to be played in succession. The following functions can be configured using the Edit ROM function.

• Continuous playback (The specified number of continuous playbacks is unlimited, depending only on the memory capacity.)
• Silence insertion function (20ms to 1,024ms)

The Edit ROM function enables efficient use of the sound code data. Also, phrases can be played back continuously in a single process without sending commands each time with an MCU, significantly reducing CPU load.

[Phrase Configuration Example using the Edit ROM Function]

Phrase 1	It's	sunny	today
Phrase 2	It's	rainy	today
Phrase 3	It will be	sunny	tomorrow
Phrase 4	It will be	rainy	tomorrow
Phrase 5	It's	sunny	today	(Silence)	it will be	rainy	tomorrow

[ROM Data Conversion]

Speech Management Area	
IT's	
sunny	rainy
today	tomorrow
It will be	
Edit ROM Area	(Blank)
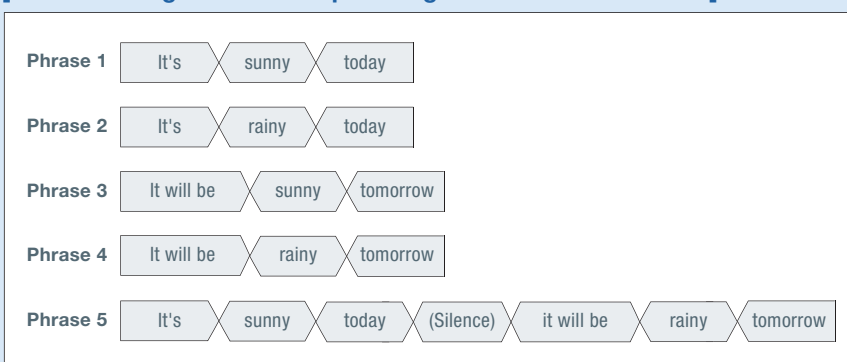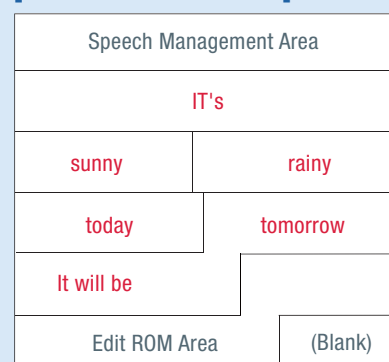
Sound playback time for each memory size and sampling frequency

■ HQ-ADPCM features a compression rate around 5x higher than that of 16bit PCM (uncompressed)

Memory size (Ex.)	16bit PCM [Sec] (Uncompressed)				ADPCM2 [Sec] (Compressed)				HQ-ADPCM [Sec] (Compressed)			
	16 kHz	12.8 kHz	10.7 kHz	8 kHz	16 kHz	12.8 kHz	10.7 kHz	8 kHz	16 kHz	12.8 kHz	10.7 kHz	8 kHz
16Mbit (2MByte)	65.5	81.9	98.0	131.1	262.1	327.7	392.0	524.3	327.7	409.6	490.0	655.4
4Mbit (512KByte)	16.4	20.5	24.5	32.8	65.5	81.9	98.0	131.1	81.9	102.4	122.5	163.8
1Mbit (128KByte)	4.1	5.1	6.1	8.2	16.4	20.5	24.5	32.8	20.5	25.6	30.6	41.0
512Kbit (64KByte)	2.0	2.6	3.1	4.1	8.2	10.2	12.2	16.4	10.2	12.8	15.3	20.5
Relationship Between Compression Rate and Playback Time (With 16bit PCM=1)	1 (16bit PCM)				4× (ADPCM2)				5× (HQ-ADPCM)			

Product Specifications

Automotive-grade Speech Synthesis LSIs (P.05 to 08)

Internal Memory Type

Part No.	Operating Voltage (V)	Operating Frequency (MHz)	Oscillator	Operating Temperature (°C)	Memory capacity (bit)	Number of Phrases	Maximum Playback Time	CPU I/F	SP Amplifier Output (W)/Class	Number of Mixing (Internal) (ch)	Others	Package	Automotive Grade	AEC-Q100 Support
ML22Q532	2.7 to 3.6 or 3.3 to 5.5	4.096 4.000	Built-in External	−40 to +105	Flash 2M	4,096	98sec*1	I²C Clock synchronization serial	1.0/ AB-class	4	Rewrite Flash from MCU*6/ Serial Audio Interface/ Failure detection	P-TQFP48-0707-0.50	✔	✔
ML22Q533					Flash 4M		201sec*1					P-TQFP48-0707-0.50	✔	✔
ML22Q535					Flash 16M		14min*1					P-TQFP48-0707-0.50	✔	—
ML22572	2.7 to 5.5	4.096	External		Mask 2M	1,024	98sec*1	Clock synchronization serial			Fail safe	P-SSOP30-56-0.65	✔	—
ML22573					Mask 4M		202sec*1					P-SSOP30-56-0.65	✔	—
ML22Q573					Flash 4M							P-SSOP30-56-0.65	✔	—
ML22Q553											Speaker terminal and short circuit detection function	P-SSOP30-56-0.65	✔	—
☆ ML22Q274	2.0 to 5.5	4.096	Built-in		Flash 692M	30	28sec*2	Clock synchronization serial	1.0/D-class (up to 85°C) 0.8/D-class (up to 105°C)	1	Disconnection and short circuit detection function	P-TSSOP20-0225-0.65	✔	✔
☆ ML22Q284								Stand-alone				P-TSSOP20-0225-0.65	✔	✔
☆ ML22Q294								I²C				P-TSSOP20-0225-0.65	✔	✔
New ML22Q374P								Clock synchronization serial				P-TSSOP20-0225-0.65	✔	✔
New ML22Q394P								I²C				P-TSSOP20-0225-0.65	✔	✔

☆: Under Development

External Memory Type

Part No.	Operating Voltage (V)	Operating Frequency (MHz)	Oscillator	Operating Temperature (°C)	Memory capacity (bit)	Number of Phrases	Maximum Playback Time	CPU I/F	SP Amplifier Output (W)/Class	Number of Mixing (Internal) (ch)	Others	Package	Automotive Grade	AEC-Q100 Support
ML22530	2.7 to 3.6 or 3.3 to 5.5	4.096 4.000	Built-in External	−40 to +105	External maximum 128M	4,096	109min*1	I²C/Clock synchronization serial	1.0/ AB-class	4	Rewrite Flash from MCU*6/Serial Audio Interface/Failure detection	P-TQFP48-0707-0.50	✔	Preparing
ML22594	4.5 to 5.5	4.096	External		Mask 6M*4 External maximum 128M	1,024*5 (Built-in 512/ External 512)	Built-in 304sec*1 External 109min*3	Clock synchronization serial			Speaker terminal and short circuit detection function	P-SSOP30-56-0.65	✔	✔

*1 Maximum playback time when the sampling frequency is 6.4kHz in HQ-ADPCM. *2 Maximum playback time when the sampling frequency is 6.4kHz in ADPCM2.
*3 With an external memory module (Max 128Mbit). Maximum playback time when the sampling frequency is 6.4kHz in HQ-ADPCM. *4 Mask´s built-in ROM is 6Mbit and an external memory module (Max 128Mbit) can be connected.
*5 Total of mask´s internal 512 phrases and external memory´s 512 phrases. *6 While using it clock synchronization serial.

Short playback Speech Synthesis LSIs (P.12)

Internal D-class Speaker Amplifier Type

Part No.	Operating Voltage (V)	Operating Frequency (MHz)	Oscillator	Operating Temperature (°C)	Memory capacity (bit)	Number of Phrases	Maximum Playback Time	CPU I/F	SP Amplifier Output (W)/Class	Number of Mixing (Internal) (ch)	Others	Package	Automotive Grade	AEC-Q100 Support
☆ ML22Q234	2.0 to 5.5	8.192	Built-in	−40 to +105	(TBD)	62	(TBD)	Clock synchronization serial	1.0/ D-class	1	Disconnection and short circuit detection function	P-TSSOP20-0225-0.65	—	—
☆ ML22Q244								Stand-alone				P-TSSOP20-0225-0.65	—	—
☆ ML22Q254								I²C				P-TSSOP20-0225-0.65	—	—

Internal AB-class Speaker Amplifier Type

Part No.	Operating Voltage (V)	Operating Frequency (MHz)	Oscillator	Operating Temperature (°C)	Memory capacity (bit)	Number of Phrases	Maximum Playback Time	CPU I/F	SP Amplifier Output (W)/Class	Number of Mixing (Internal) (ch)	Others	Package	Automotive Grade	AEC-Q100 Support
ML22562	2.7 to 5.5	4.096	External	−40 to +85	Mask 2M	1,024	99sec*1	Clock synchronization serial	1.0/ AB-class	4	Fail safe	P-SSOP30-56-0.65	—	—
ML22563					Mask 4M		202sec*1					P-SSOP30-56-0.65	—	—
ML22Q563					Flash 4M							P-SSOP30-56-0.65	—	—

*1 Maximum playback time when the sampling frequency is 6.4kHz in ADPCM2.

☆: Under Development

Speech MCUs (P.14)

8bit ML610Q300
Speech Play Back MCU (8bit)

Part No.	Operating Voltage (V)	ROM type	ROM Capacity (Byte)	Data Flash Capacity (Byte)	Memory capacity	RAM Capacity (Byte)	Port Input	Port Output	Port Input/Output	Operating Frequency (Max) Low Speed	Operating Frequency (Max) High Speed	Minimum Instruction Execution Time	Current Consumption (Typ@HALT)	Operating Temperature (°C)
ML610Q304	2.0 to 5.5	Flash	96K	2K	Flash ROM	1K	1	3	11	32.768kHz (Internal RC oscillation)	8.192MHz	0.122µs/ 30.5µs	2.7µA	−40 to +85
☆ ML610Q305									12				(TBD)	
☆ ML610Q306									15					

Long playback Speech Synthesis LSIs (P.09 to P.11)

Internal Flash Memory Type

Part No.	Operating Voltage (V)	Operating Frequency (MHz)	Oscillator	Operating Temperature (°C)	Memory capacity (bit)	Number of Phrases	Maximum Playback Time	CPU I/F	SP Amplifier Output (W)/Class	Number of Mixing (Internal) (ch)	Others	Package	Industrial Grade
ML22Q623	2.7 to 3.6 or 3.3 to 5.5	4.096 4.000	Built-in External	−40 to +70	Flash 4M	4,096*2	192sec*3	Clock synchronous serial	1.0/ AB-class, D-class	4	Rewrite Flash from MCU/ Failure detection	P-TQFP32-0707-0.80 P-WQFN32-0505-0.50	✔
ML22Q624					Flash 8M		397sec*3						✔
ML22Q625					Flash 16M		13min*3						✔
ML22Q626					Flash 32M		27min*3						✔
ML22Q663					Flash 4M		192sec*3	I²C			Failure detection		✔
ML22Q664					Flash 8M		397sec*3						✔
ML22Q665					Flash 16M		13min*3						✔
ML22Q666					Flash 32M		27min*3						✔

Internal P2ROM™ Memory Type

Part No.	Operating Voltage (V)	Operating Frequency (MHz)	Oscillator	Operating Temperature (°C)	Memory capacity (bit)	Number of Phrases	Maximum Playback Time	CPU I/F	SP Amplifier Output (W)/Class	Number of Mixing (Internal) (ch)	Others	Package	Industrial Grade
ML22723	2.7 to 3.6 or 3.3 to 5.5	4.096	External	−40 to +85	P2ROM™ 4M	4,096*2	161sec*1	Clock synchronous serial	0.7/ AB-class	1	Speech-speed and pitch conversion	P-SSOP30-56-0.65	✔
ML22724					P2ROM™ 8M		325sec*1					P-SSOP30-56-0.65	✔
ML22725					P2ROM™ 16M		11min*1					P-SSOP30-56-0.65	✔
ML22763					P2ROM™ 4M		161sec*1	I²C				P-SSOP30-56-0.65	✔
ML22764					P2ROM™ 8M		325sec*1					P-SSOP30-56-0.65	✔
ML22765					P2ROM™ 16M		11min*1					P-SSOP30-56-0.65	✔

*1 Maximum playback time when the sampling frequency is 6.4kHz in ADPCM2. *2 1024 phrases (1 bank)×4 banks. *3 Maximum playback time when the sampling frequency is 6.4kHz in HQ-ADPCM.

Supports external memory Speech Synthesis LSIs (P.13)

Internal AB-class/D-class Speaker Amplifier Type

Part No.	Operating Voltage (V)	Operating Frequency (MHz)	Oscillator	Operating Temperature (°C)	Memory capacity (bit)	Number of Phrases	Maximum Playback Time	CPU I/F	SP Amplifier Output (W)/Class	Number of Mixing (Internal) (ch)	Others	Package	Industrial Grade
ML22620	2.7 to 3.6 or 3.3 to 5.5	4.096 4.000	Built-in External	−40 to +85	External maximum 128M	4,096	109min*2	Clock synchronization serial	1.0/ AB-class, D-class	4	Rewrite Flash from MCU/Failure detection	P-TQFP32-0707-0.80 P-WQFN32-0505-0.50	✔
ML22660								I²C			Failure detection		✔

Internal AB-class Speaker Amplifier Type

Part No.	Operating Voltage (V)	Operating Frequency (MHz)	Oscillator	Operating Temperature (°C)	Memory capacity (bit)	Number of Phrases	Maximum Playback Time	CPU I/F	SP Amplifier Output (W)/Class	Number of Mixing (Internal) (ch)	Others	Package	Industrial Grade
ML22420	2.7 to 5.5	4.096	External	−40 to +85	External maximum 128M	1,024	87min*1	Clock synchronization serial	0.7/ AB-class	4	—	P-SSOP30-56-0.65	✔
ML22460								I²C					✔

*1 Maximum playback time when the sampling frequency is 6.4kHz in ADPCM2.
*2 With an external memory module (Max 128Mbit). Maximum playback time when the sampling frequency is 6.4kHz in HQ-ADPCM.

8bit Timer	PWM	WDT	ADC (method)	Serial Port			Supply Voltage Detection	LCD Driver	External Interrupt Sources	SP Amp Output (W)/Class	Others	Notes	Package	Industrial Grade
				I²C	SSIO	UART								
4 (16bit×2)	—	1	10bit×3 (SA type)	Master/ Slave ×1	2	Half Duplex ×1	—	LLD×1	9	1.0 (@5V)/ D-class	Speech function/ ADPCM2 decoder/ Built-in speaker Amplifier	—	P-VQFN28-0505-0.50 P-SSOP30-56-0.65 P-WQFN32-0505-0.50	✔
											Speech function/ ADPCM2 HQ-ADPCM decoder/ Built-in speaker Amplifier		P-WQFN32-0505-0.50 P-TQFP32-0707-0.80	✔
			10bit×4 (SA type)										P-WQFN36-0606-0.50	✔

☆: Under Development