

OKI Semiconductor

FEDL66592-01

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ML66592/66Q592

OLMS-66K Series CMOS 16-Bit Microcontroller

GENERAL DESCRIPTION

The ML66592/66Q592 is a high speed, high performance 16-bit microcontroller that employs an Oki-original nX-8/500S CPU core. The ML66592/66Q592 contains a 16-bit CPU, ROM, RAM, a 10-bit A/D converter, serial ports, flexible timers, and PWMs.

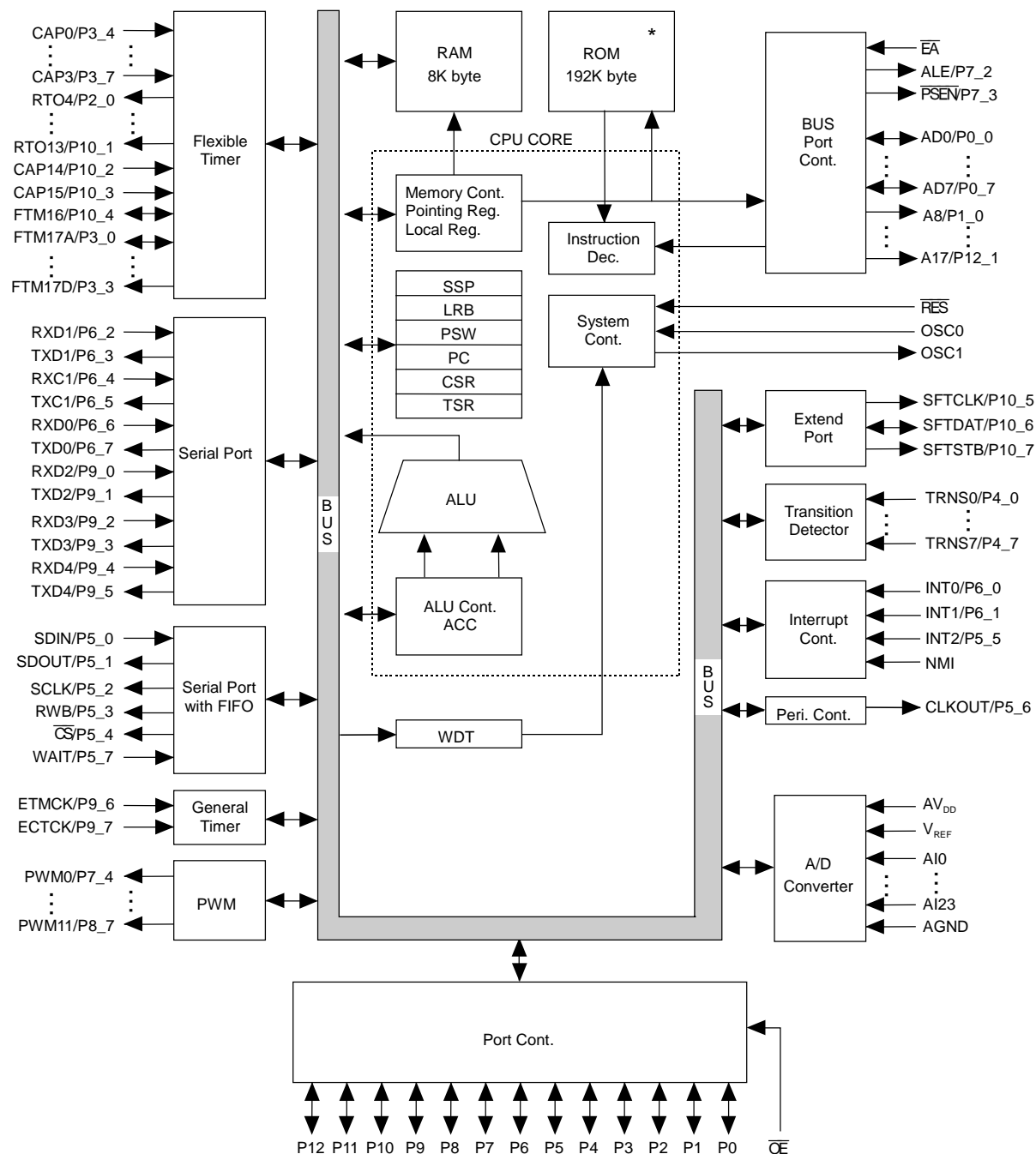
The ML66Q592 is a Flash EEPROM version.

FEATURES

- Abundant Instruction Set
 - Instruction set has superb orthogonal capability
 - 8/16-bit arithmetic instructions
 - Multiplication/division instructions
 - Bit operation instructions
 - Bit logic operation instructions
 - ROM table reference instructions
- Abundant Addressing Modes
 - Register addressing
 - Page addressing
 - Pointing register indirect addressing
 - Stack addressing
 - Immediate addressing
- Minimum Instruction Cycle
 - 71.4 ns @ 14 MHz (internal: 28 MHz)
- Program Memory (ROM)
 - Internal : 192K bytes
 - External : 256K bytes, \overline{EA} pin active
- Data memory (RAM)
 - Internal : 8K bytes
- I/O Ports
 - Analog input ports : 24
 - I/O ports : 98
- Multiplier (MUL ERn instruction: 178.6 ns @ 14 MHz)

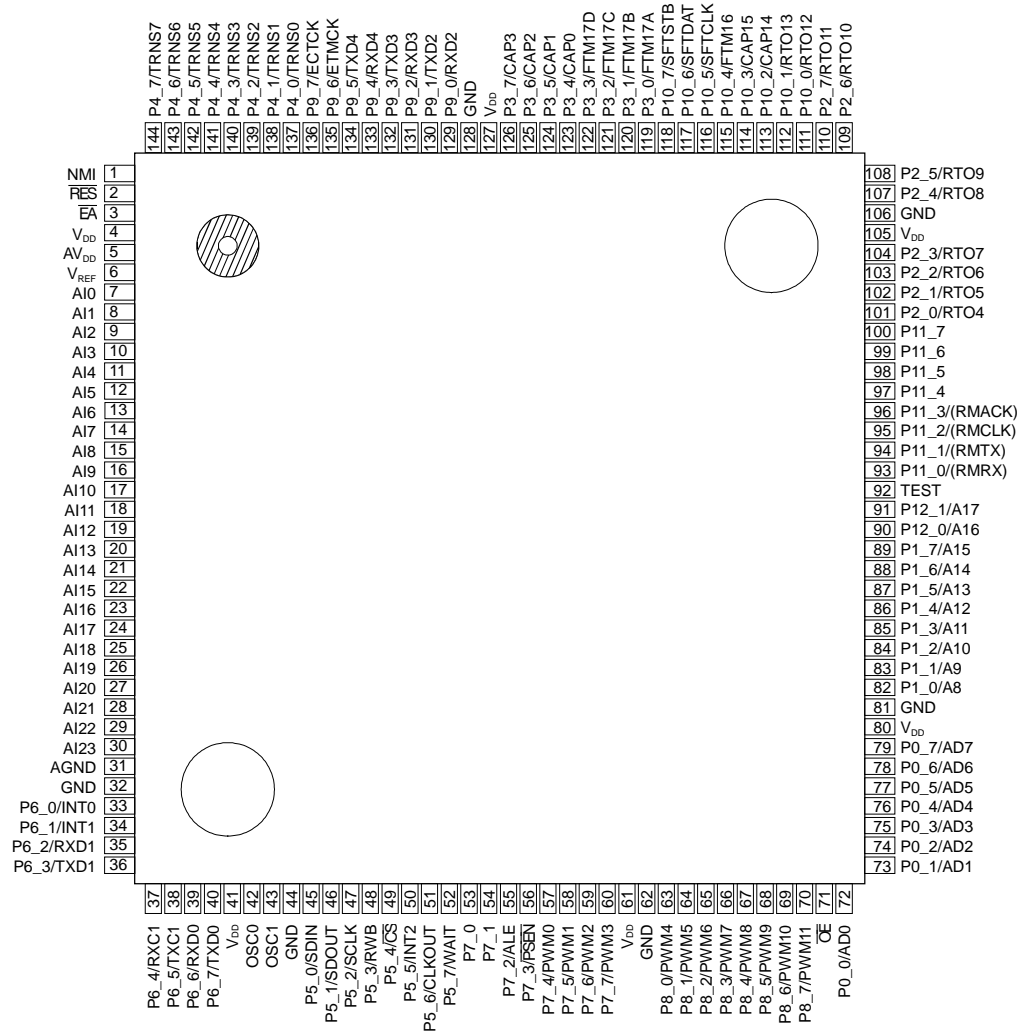
- Flexible Timer
 - Freerun counter : 20-bit × 1, 16-bit × 1
 - Capture register with divider : 6
 - Double-buffer realtime output : 10
 - Multifunction timer : 2
- General-Purpose 8-Bit Timers
 - General-purpose 8-bit timer : 1
 - 8-bit event counter : 1
- 16-Bit PWM : 12
- 8-Bit Serial Ports
 - UART with BRG (provided with a 4-stage buffer on the receive side) : 4
 - UART/synchronous type with BRG : 1
 - Synchronous (with 8-byte FIFO) : 1
- A/D Converter
 - 10-bit resolution : 24 channels (12-channel × 2)
- Transition Detector : 8
- Watchdog Timer : 1
- Expansion Port (serial-parallel conversion) : 1
- Interrupts
 - Non-maskable : 1
 - Maskable : internal: 63/external: 3 (38 vectors)
4-level priority
- ROM Window Functions
- RAM Monitor Functions
- Standby Modes
 - HALT mode
 - STOP mode
- Clock Multiplier (2 × original oscillation clock)
- Package
 - 144-pin plastic LQFP (LQFP144-P-2020-0.50-K) (ML66592-xxxTCZ200)
(ML66Q592-xxxTCZ200)
xxx indicates the code number.

BLOCK DIAGRAM



* The ML66Q592 is a Flash EEPROM (192K bytes) version.

PIN CONFIGURATION (TOP VIEW)



144-Pin Plastic LQFP

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition		Rating	Unit
Digital Power Supply Voltage	V_{DD}	GND = AGND = 0 V $T_a = 25^\circ\text{C}$		-0.3 to +7.0	V
Input Voltage	V_I			-0.3 to $V_{DD} + 0.3$	V
Output Voltage	V_O			-0.3 to $V_{DD} + 0.3$	V
Analog Power Supply Voltage	AV_{DD}			-0.3 to $V_{DD} + 0.3$	V
Analog Reference Voltage	V_{REF}			-0.3 to $V_{DD} + 0.3$ and -0.3 to $AV_{DD} + 0.3$	V
Analog Input Voltage	V_{AI}			-0.3 to V_{REF}	V
High-voltage Tolerant Input Voltage ^{*2}	V_{HV}			-0.3 to +13	V
Power Dissipation	P_D	$T_a = 95^\circ\text{C}$ ^{*1}	per package	730	mW
			per output	50	mW
Storage Temperature	T_{STG}	—		-50 to +150	$^\circ\text{C}$

^{*1} If this device is used in circumstances where the ambient temperature (T_a) exceeds 85°C , be sure to contact your local Oki sales office in advance.

^{*2} Applied to TEST, \overline{EA} (only for ML66Q592)

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	Range	Unit
Digital Power Supply Voltage	V_{DD}	$20 \text{ MHz} \leq f_{OSC} \leq 28 \text{ MHz}$ *1	4.5 to 5.5	V
Analog Power Supply Voltage	AV_{DD}	$V_{DD} = AV_{DD}$	4.5 to 5.5	V
Analog Reference Voltage	V_{REF}	—	$AV_{DD} - 0.3$ to AV_{DD}	V
Analog Input Voltage	V_{AI}	—	AGND to V_{REF}	V
Memory Hold Voltage	V_{DDH}	$f_{OSC} = 0 \text{ Hz}$ *1	2.0 to 5.5	V
Operating Frequency	f_{OSC} *1	$V_{DD} = 5 \text{ V} \pm 10\%$	20 to 28	MHz
Ambient Temperature	T_a *2	—	-40 to +95	°C
Fanout	N	MOS load	20	—
		P0, P7_0–P7_3	2	—
		P1–P12 (except P7_0–P7_3)	1	—
Digital Power Supply Voltage during Flash ROM Programming *3	V_{WR}	$T_a = -40$ to $+90^\circ\text{C}$	4.75 to 5.25	V
Ambient Temperature during Flash ROM Programming *3	T_{WR}	$V_{DD} = 4.75$ to 5.25 V	-40 to +90	°C
Flash ROM Programming Cycle *3	C_{WR}	$T_a = -40$ to $+90^\circ\text{C}$ $V_{DD} = 4.75$ to 5.25 V	100	cycle

*1 f_{OSC} is the frequency of the internal master clock (the master clock is the frequency generated by multiplying the original oscillation clock by 2).

*2 If this device is used in circumstances where the ambient temperature (T_a) exceeds 85°C , be sure to contact your local Oki sales office in advance.

*3 Only for ML66Q592

ELECTRICAL CHARACTERISTICS

DC Characteristics

(V_{DD} = 5 V ±10%, T_a = -40 to +95°C)^{*2}

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
"H" Level Input Voltage 1	V _{IH}	—	2.2	—	V _{DD} + 0.3	V
"H" Level Input Voltage 2, 4, 5, 6, 7			0.80V _{DD}	—	V _{DD} + 0.3	
"L" Level Input Voltage 1	V _{IL}	—	−0.3	—	0.8	
"L" Level Input Voltage 2, 4, 5, 6, 7			−0.3	—	0.2V _{DD}	
"H" Level Output Voltage 1, 4	V _{OH}	I _O = −400 μA	V _{DD} − 0.4	—	—	
"H" Level Output Voltage 2		I _O = −200 μA	V _{DD} − 0.4	—	—	
"L" Level Output Voltage 1, 4	V _{OL}	I _O = 3.2 mA	—	—	0.4	
"L" Level Output Voltage 2		I _O = 1.6 mA	—	—	0.4	
Input Leakage Current 3	I _{IH} /I _{IL}	V _I = V _{DD} /0 V	—	—	0.1/−0.1	μA
Input Leakage Current 6			—	—	1/−1	
Input Current 5			—	—	1/−250	
Input Current 7			—	—	15/−15	
"H" Level Output Current 1, 4	I _{OH}	V _O = 2.4 V	−2	—	—	mA
"H" Level Output Current 2			−1	—	—	
"L" Level Output Current 1, 4	I _{OL}		10	—	—	
"L" Level Output Current 2			5	—	—	
Output Leakage Current 1, 2, 4	I _{LO}	V _O = V _{DD} /0 V	—	—	±2	μA
Input Capacity	C _I	f = 1 MHz , Ta = 25°C	—	5	—	pF
Output Capacity	C _O		—	7	—	
Analog Reference Power Supply Current	I _{REF}	A/D conversion in progress	—	—	12	mA
		A/D conversion stopped	—	—	10	μA
Supply Current (in STOP mode)	I _{DDS}	V _{DD} = 2 V, Ta = 25°C*	—	0.2	10	μA
		*	—	1	100	
Supply Current (in HALT mode)	I _{DDH}	f _{OSC} = 28 MHz, *1 No Load	—	65	90	mA
Supply Current	I _{DD}		—	95	120	
High-voltage Tolerant Input Voltage *3, *4	V _{IHV}	V _{DD} = 4.75 to 5.25 V	V _{DD} + 4.75	—	12	V
High-voltage Tolerant Input Current *3, *4	I _{IHV}	V _{DD} = 4.75 to 5.25 V V _{IHV} = V _{DD} + 0.3 to 12 V	—	—	1	mA

1. Applied to P0
2. Applied to P1–P12 (excluding P7_0–P7_3)
3. Applied to AI0–AI23
4. Applied to P7_0–P7_3
5. Applied to RES
6. Applied to EA, OE, NMI
7. Applied to OSC0

* Ports configured to be input should be connected to V_{DD} or 0 V; other ports should take no load.

- *1 f_{OSC} is the frequency of the internal master clock.
- *2 If this device is used in circumstances where the ambient temperature (T_a) exceeds 85°C, be sure to contact your local Oki sales office in advance.
- *3 Applied to TEST, \overline{EA} (only for ML66Q592)
- *4 When programming data into Flash ROM using the Oki's Flash ROM programmer or YDC's Flash ROM programmer, use a resistor of 1 k Ω or less if connecting an external resistor in series with the TEST pin.
Apply a high voltage to the TEST or \overline{EA} pin after a voltage within the range (4.75 to 5.25 V) guaranteed for operation is applied to V_{DD} .
Remove a high voltage from the TEST or \overline{EA} pin while a voltage within the range (4.75 to 5.25 V) guaranteed for operation is being applied to V_{DD} .

AC Characteristics

External Program Memory Control

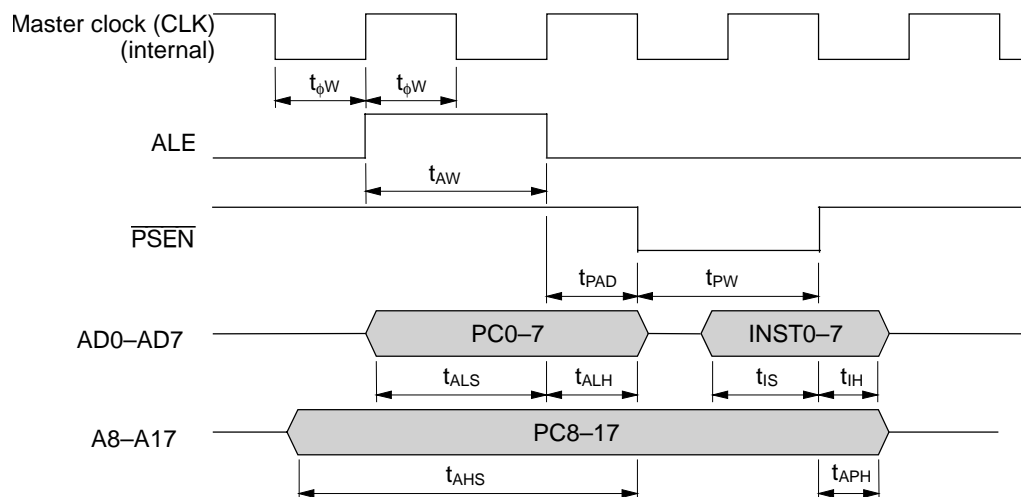
($V_{DD} = 5\text{ V} \pm 10\%$, $T_a = -40$ to $+95^\circ\text{C}$)*²

Parameter	Symbol	Condition	Min.	Max.	Unit
Master Clock (CLK) Pulse Width	$t_{\phi W}$ ^{*1}	—	20.8	25	ns
ALE Pulse Width	t_{AW}	$t_{\phi W} > 20.8\text{ ns}$ ^{*3} $C_L = 50\text{ pF}$	$2t_{\phi W} - 10$	—	
$\overline{\text{PSEN}}$ Pulse Width	t_{PW}		$2t_{\phi W} - 10$	—	
$\overline{\text{PSEN}}$ Pulse Delay Time	t_{PAD}		$t_{\phi W} - 10$	$t_{\phi W} + 10$	
Low Address Setup Time	t_{ALS}		$2t_{\phi W} - 15$	$2t_{\phi W} + 3$	
Low Address Hold Time	t_{ALH}		$t_{\phi W} - 10$	$t_{\phi W} + 10$	
High Address Setup Time	t_{AHS}		$3t_{\phi W} - 10$	$4t_{\phi W} + 3$	
High Address Hold Time	t_{APH}		0	$t_{\phi W} + 10$	
Instruction Setup Time	t_{IS}		30	—	
Instruction Hold Time	t_{IH}		0	$t_{\phi W} - 10$	

*1 The master clock pulse is the frequency generated by multiplying the original oscillation clock by 2.

*2 If this device is used in circumstances where the ambient temperature (T_a) exceeds 85°C , be sure to contact your local Oki sales office in advance.

*3 The electrical characteristics for external memory access apply for $20.8 < t_{\phi W} < 25\text{ ns}$.



A/D Converter Characteristics

($T_a = -40$ to $+95^\circ\text{C}$, $AV_{DD} = V_{DD} = V_{REF} = 5\text{ V} \pm 10\%$, $AGND = GND = 0\text{ V}$, $f_{OSC} = 28\text{ MHz}$)^{*1, 2}

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Resolution	n	Refer to the measurement circuit (Figure 1)	—	—	10	Bit
Linearity Error	E_L	Analog input source impedance $R_I \leq 5\text{ k}\Omega$ $t_{CONV} = 18.3\text{ }\mu\text{s}$	—	—	± 3	LSB
Differential Linearity Error	E_D		—	—	± 1	
Zero Scale Error	E_{ZS}		—	—	+3	
Full Scale Error	E_{FS}		—	—	-3	
Crosstalk	E_{CT}	Refer to the measurement circuit (Figure 2)	—	—	± 1	
Conversion Time	t_{CONV}	by ADTM set data	9.1	—	18.3	$\mu\text{s/ch}$

*1 f_{OSC} is the frequency of the internal master clock (the master clock is the frequency generated by multiplying the original oscillation clock by 2).

*2 If this device is used in circumstances where the ambient temperature (T_a) exceeds 85°C , be sure to contact your local Oki sales office in advance.

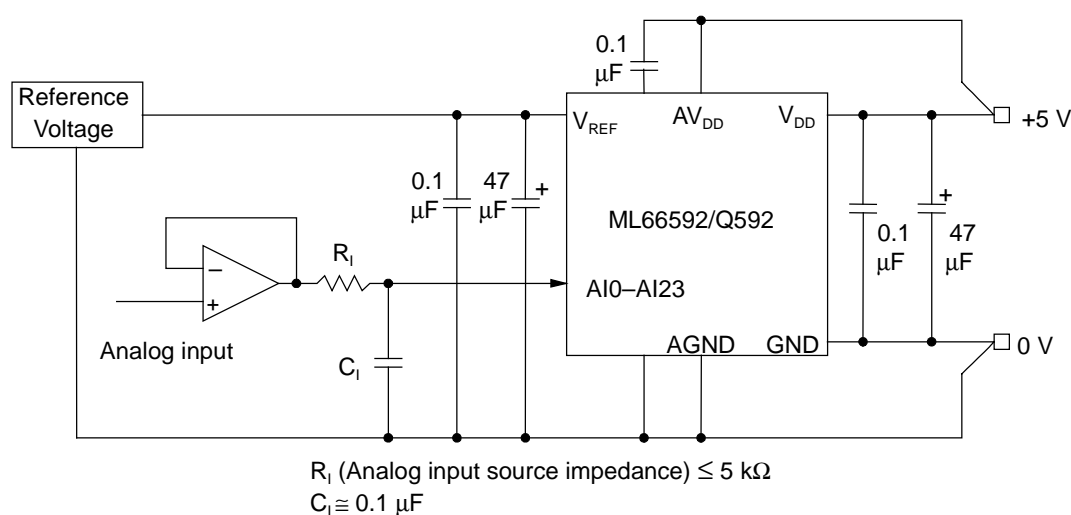


Figure 1 Measurement Circuit

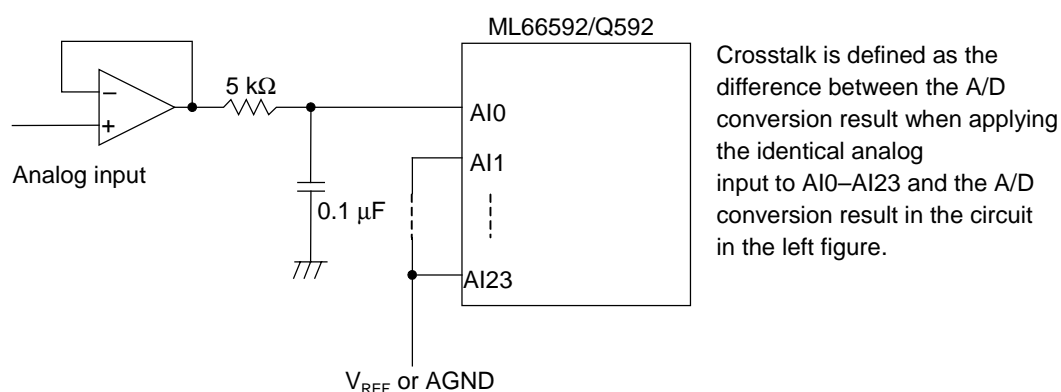


Figure 2 Crosstalk Measurement Circuit

Definition of Terminology

1. Resolution

Resolution is the value of minimum discernible analog input.

With 10 bits, since $2^{10} = 1024$, resolution of $(V_{REF} - AGND) \div 1024$ is possible.

2. Linearity error

Linearity error is the difference between ideal conversion characteristics and actual conversion characteristics of a 10-bit A/D converter (not including quantization error).

Ideal conversion characteristics can be obtained by dividing the voltage between V_{REF} and AGND into 1024 equal steps.

3. Differential linearity error

Differential linearity error indicates the smoothness of conversion characteristics.

Ideally, the range of analog input voltage that corresponds to 1 converted bit of digital output is $1\text{LSB} = (V_{REF} - AGND) \div 1024$. Differential error is the difference between this ideal bit size and bit size of an arbitrary point in the conversion range.

4. Zero scale error

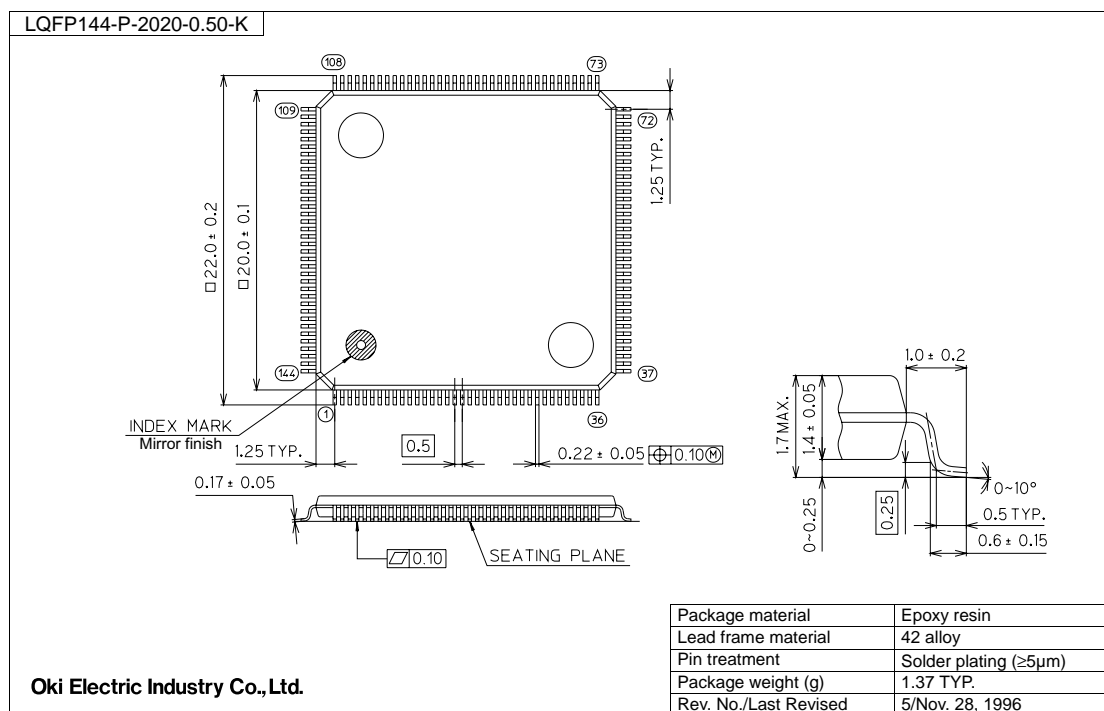
Zero scale error is the difference between ideal conversion characteristics and actual conversion characteristics at the point where the digital output changes from 000H to 001H.

5. Full-scale error

Full-scale error is the difference between ideal conversion characteristics and actual conversion characteristics at the point where the digital output changes from 3FEH to 3FFH.

PACKAGE DIMENSIONS

(Unit: mm)



Notes for Mounting the Surface Mount Type Package

The surface mount type packages are very susceptible to heat in reflow mounting and humidity absorbed in storage.

Therefore, before you perform reflow mounting, contact Oki's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

REVISION HISTORY

Document No.	Date	Page		Description
		Previous Edition	Current Edition	
FEDL66592-01	Mar. 22, 2002	–	–	First edition

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