RICOH

REAL-TIME CLOCK

RP/RF/RJ5C15

NO. EK-086-9908

OUTLINE

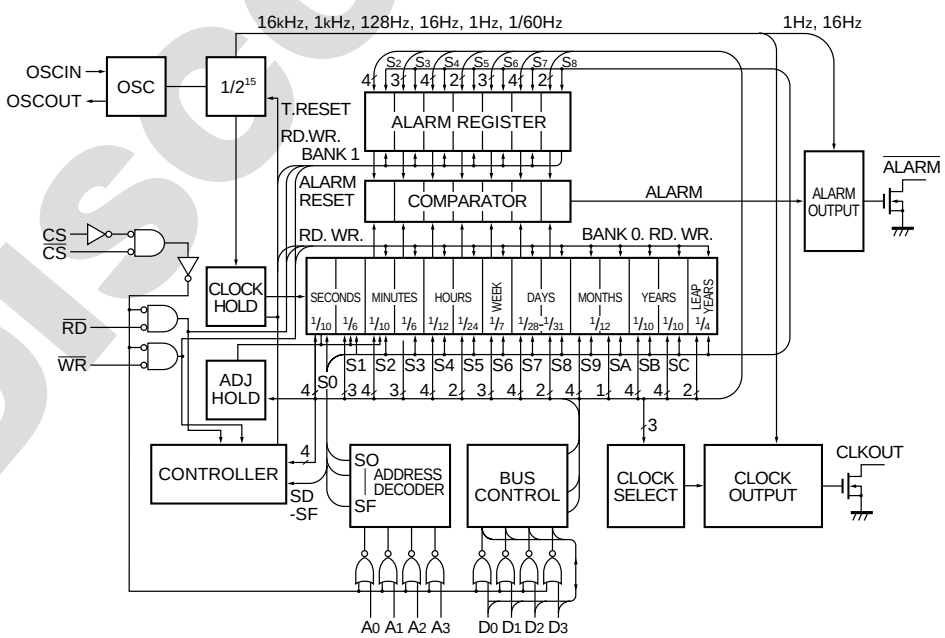
The RP/RF/RJ5C15 are real-time clocks for microcomputers that can be connected directly to data buses of 16bit CPUs, such as the 8086, Z8000, and 68000, and of 8bit CPUs, such as the 8085A, Z80, 6809, and 6502. They allow setting or reading of the clock with the same procedures as for the Read/Write operation for memory.

These products have various features including clock, calendar and alarm functions and can be backed up by batteries.

FEATURES

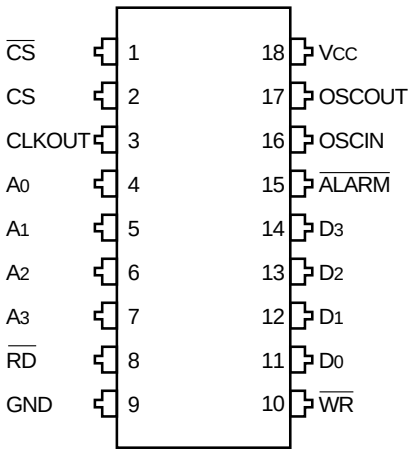
- Connected directly to CPU enabling fast access.
- 4bit bidirectional data bus : D0 - D3
- 4bit address input : A0 - A3
- Built-in clock counter (hour, minute, second) and calendar counter (leap year, year, month, day, day-of-the-week)
- All clock data expressed in BCD codes
- Backed up by batteries (minimum : 2.0V)
- Selectable basic clock frequency : 16kHz, 1kHz, 128Hz, 16Hz, 1Hz, 1/60Hz.
- Outputs alarm signals or timing pulse of 16Hz or 1Hz.
- CMOS technology
- Supply voltage : Single power supply of +5V
- Packages RP5C15·····18pin DIP
  RF5C15·····18pin SOP
  RJ5C15·····28pin PLCC

BLOCK DIAGRAM

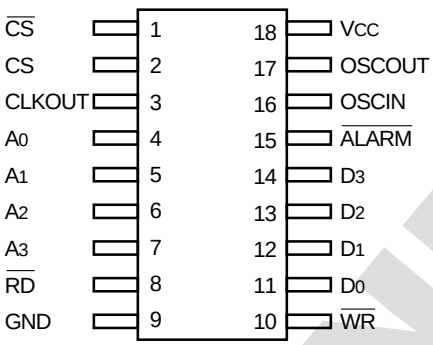


PIN CONFIGURATIONS

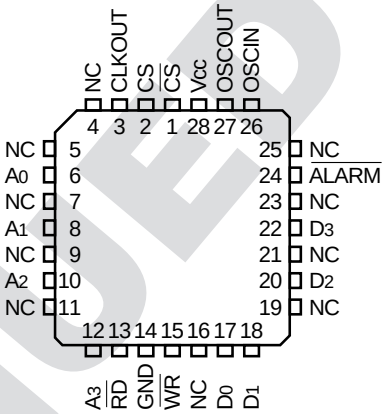
• RP5C15 (18pin DIP)



• RF5C15 (18pin SOP)



• RJ5C15 (28pin PLCC)



PIN DESCRIPTION

Pin No.	Symbol	Function
1,2	$\overline{CS}$, CS	The $\overline{CS}$ and CS are used to interface with external devices. Enabled when CS ="H" and $\overline{CS}$="L". The CS is connected to the power down detector in the system power supply assembly while the $\overline{CS}$ is connected to the microcomputer.
3	CLKOUT	Output pin for reference clock pulse and an open drain output. Selectable from 8 modes based on the setting of the clock select register as shown in the separate table.
4,5,6,7	A_0 to A_3	Input pins for the address signal. These pins are connected to the CPU address bus.
8	$\overline{RD}$	Input pin for I/O control. The $\overline{RD}$ is set to "L" when data is transferred from the RP/RF/RJ5C15 to the CPU.
9	GND	Ground pin for the power supply of 0V.
10	$\overline{WR}$	Input pin for I/O control. The $\overline{WR}$ is set to "L" when data is transferred from the CPU to the RP/RF/RJ5C15.
11,12,13,14	D_0 to D_3	Bidirectional data bus. Connected to the data bus of the CPU.
15	$\overline{ALARM}$	The $\overline{ALARM}$ outputs alarm signal and 16Hz and 1Hz clock pulses. This pin is an open drain output.
16	OSCIN	The OSCIN and OSCOUT are connected to the 32.768kHz crystal oscillator.
17	OSCOUT	32.768kHz
18	V_{CC}	Input pin for the power supply of +5V.

*) Pin numbers shown are for the RP5C15 and the RF5C15. These are different for the RJ5C15. For specific pin number see the "PIN CONFIGURATIONS".

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V_{CC}	Supply Voltage		–0.3 to 7.0	V
V_I	Input Voltage	Referenced at GND pin	–0.3 to V_{CC}+0.3	V
V_O	Output Voltage		–0.3 to V_{CC}+0.3	V
Pd	Maximum Power Dissipation	Ta=25˚C	400	mW
Topr	Operating Temperature		–20 to 70	˚C
Tstg	Storage Temperature		–40 to 125	˚C

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum ratings are threshold limit values that must not be exceeded even for an instant under any conditions. Moreover, such values for any two items must not be reached simultaneously. Operation above these absolute maximum ratings may cause degradation or permanent damage to the device. These are stress ratings only and do not necessarily imply functional operation below these limits.

RECOMMENDED OPERATING CONDITIONS

(Unless otherwise specified, Ta=–20 to 70˚C)

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{CC}	Supply Voltage		4.5	5	5.5	V
V_{DH}	Data Preservation Voltage		2.0		5.5	V
f_{XT}	Crystal Oscillation Frequency			32.768		kHz

DC ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=–20 to 70˚C, Vcc=5V±10%)

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{IH}	"H" Input Voltage (excluding OSCIN)		2.0		Vcc+0.3	V
	"H" Input Voltage (OSCIN)		2.4		Vcc+0.3	V
V_{IL}	"L" Input Voltage (excluding OSCIN)		–0.3		0.8	V
	"L" Input Voltage (OSCIN)		–0.3		0.5	V
V_{OH}	"H" Output Voltage	I_{OH}=–400µA	2.4			V
V_{OL}	"L" Output Voltage	I_{OL}=2mA			0.4	V
I_{LI}	Input Leakage Current	V_{IN}=0 to Vcc	–10		10	µA
I_{OZ}	Output Off-state Leakage Current	Voz=0 to 5.5V			±10	µA
I_{CC1}	Supply Current for Backup	f_{XT}=32.768kHz, Vcc=2.0V			15	µA
I_{CC2}	Operating Supply Current	f_{XT}=32.768kHz, Vcc=5.5V*			250	µA
V_{ILCS}	CS pin "L" Input Voltage for Backup	Vcc=2.0V	–0.2		0.2	V
V_{IHCS}	CS pin "H" Input Voltage for Backup	Vcc=2.0V	1.8		2.0	V

*) RD, WR signal frequency : 100kHz ; Input pin is fixed at Vcc or GND level ; output pin open.

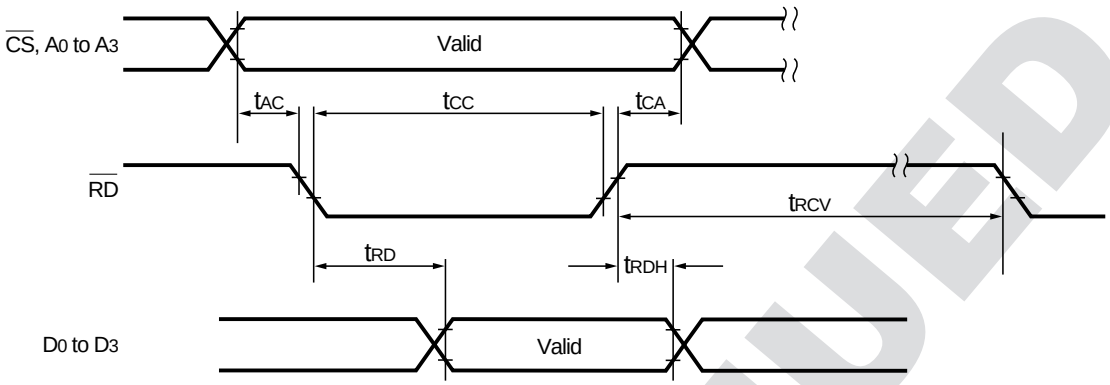
AC ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=–20 to 70˚C, Vcc=5V±10%)

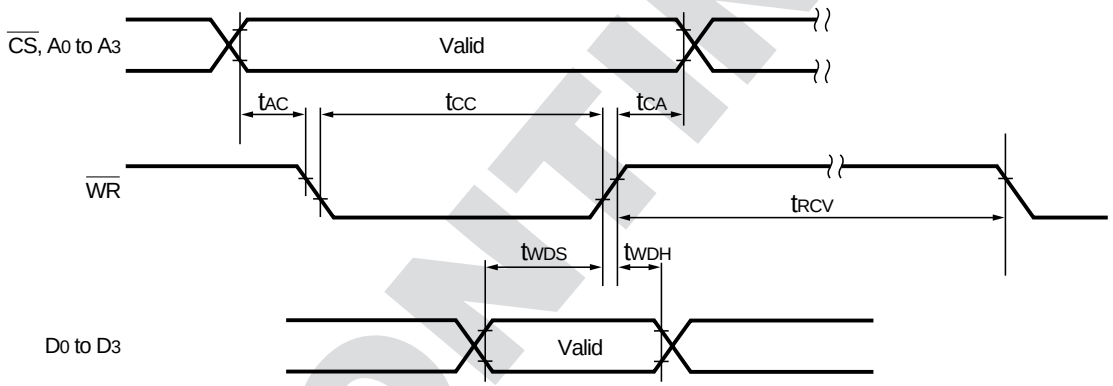
Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
t_{AC}	Address–$\overline{RD}$/$\overline{WR}$ Delay Time		50			ns
tcc	$\overline{RD}$/$\overline{WR}$ Pulse Width		120		13000	ns
t_{CA}	Address Effective Time after rising of $\overline{RD}$/$\overline{WR}$		10			ns
t_{RD}	Data Delay Time after falling of $\overline{RD}$	1TTL+100pF			120	ns
t_{RDH}	Data Hold Time after rising of $\overline{RD}$		10			ns
t_{WDS}	Data Setup Time in Write operation		100			ns
t_{WDH}	Data Hold Time in Write operation		20			ns
t_{TED}	Timer Enable to Timer Disable		100			µs
t_{ADJ}	Adjust Completion Time				100	µs
t_{AINH}	Alarm Write Inhibit Time after Resetting		100			µs
t_{RCV}	$\overline{RD}$/$\overline{WR}$ Recovery Time		1			µs

TIMING CHART

• **Read Cycle**



• **Write Cycle**



ADDRESS MAPPING

MODE	BANK 0					BANK 1				
A3 to A0	Description	D3	D2	D1	D0	Description	D3	D2	D1	D0
0	1-second counter					Clock output select register	×			
1	10-second counter	×				Adjust	×	×	×	ADJ
2	1-minute counter					1-minute alarm register				
3	10-minute counter	×				10-minute alarm register	×			
4	1-hour counter					1-hour alarm register				
5	10-hour counter	×	×			10-hour alarm register	×	×		
6	Day-of-the-week counter	×				Day-of-the-week alarm register	×			
7	1-day counter					1-day alarm register				
8	10-day counter	×	×			10-day alarm register	×	×		
9	1-month counter						×	×	×	×
A	10-month counter	×	×	×		$\overline{12}$/24 select register	×	×	×	
B	1-year counter					Leap year counter	×	×		
C	10-year counter						×	×	×	×
D	MODE register	Timer EN	Alarm EN	×	BANK1/0		Timer EN	Alarm EN	×	BANK1/0
E	TEST register	Test 3	Test 2	Test 1	Test 0		Test 3	Test 2	Test 1	Test 0
F	RESET controller, etc.	$\overline{\text{1Hz ON}}$	$\overline{\text{16Hz ON}}$	Timer RESET	Alarm RESET		$\overline{\text{1Hz ON}}$	$\overline{\text{16Hz ON}}$	Timer RESET	Alarm RESET

∗) "x" means "Don't care" for Write ; always "0" for Read.

• Clock Output Select Register (BANK 1, Address 0h)

D3	D2	D1	D0	Clock Output	Remarks
×	0	0	0	"Z"	High impedance
×	0	0	1	16.384kHz	duty 50%
×	0	1	0	1.024kHz	duty 50%
×	0	1	1	128Hz	duty 50%
×	1	0	0	16Hz	duty 50%
×	1	0	1	1Hz	duty 50% ∫ When the second counter counts up.
×	1	1	0	1/60Hz	duty 50% ∫ When the second counter counts up.
×	1	1	1	"L"	

∗) "x" means "Don't care" for Write ; always "0" for Read.

• **ADJ (BANK1, Address 1h, D_0)**

Bit for correcting the second digit. When set to 1,

1) For digits ranging from 00 to 29 : Resets the lower-order counter than the 1-second counter and sets the second digit to 00.

2) For digits ranging from 30 to 59 : Resets the lower-order counter than the 1-second counter, sets the second digit to 00 and increments the minute digit by 1.

• **MODE register (BANK1/0, Address Dh)**

D_3	D_2	D_1	D_0
Timer EN	Alarm EN	×	BANK1/0

D_0: 1: BANK1 : Setting and reading of alarm, $\overline{12\text{-hour}}$/24-hour, leap year, clock output selection and adjust operation.
0: BANK0 : Setting and reading of time

D_2: 1: Alarm output enable
0: Alarm output disable
(Note that 16Hz or 1Hz signals are not affected.)

D_3: 1: Counting time starts ; 0 : the 1-second counter and higher-order counters than the 1-second counter stop*

*) When the Timer EN is set to 0, the 1-second counter and higher-order counters than the 1-second counter stop. If any carrying occurs in the lower-order counters than the 1-second counter while the Timer EN is 0, carrying will be held and avoided until the Timer EN changes from 0 to 1. Thus, no apparent delay is produced when the duration of the Timer EN = 0 is less than one second.

• **$\overline{12}$/24 select register (BANK1, Address Ah)**

D_0=1 sets to 24-hour system ; D_0=0 sets to 12-hour system.
Set the 10-hour counter as D_1=1 for p.m., D_1=0 for a.m.

• **Leap year counter (BANK1, Address Bh)**

(D_1, D_0)=(0, 0) sets the counter for leap years. The counter value changes in the order of (0, 0) (0, 1) (1, 0) (1, 1) (0, 0) repeatedly in the same timing as the year counter.

• **RESET controller/16Hz · 1Hz clock register. (BANK1/0, Address Fh)**

D_0=1 : Resets all alarm registers.
D_1=1 : Resets divider stages for seconds or smaller units.
D_2=0 : 16Hz clock pulse ON.
D_3=0 : 1Hz clock pulse ON.

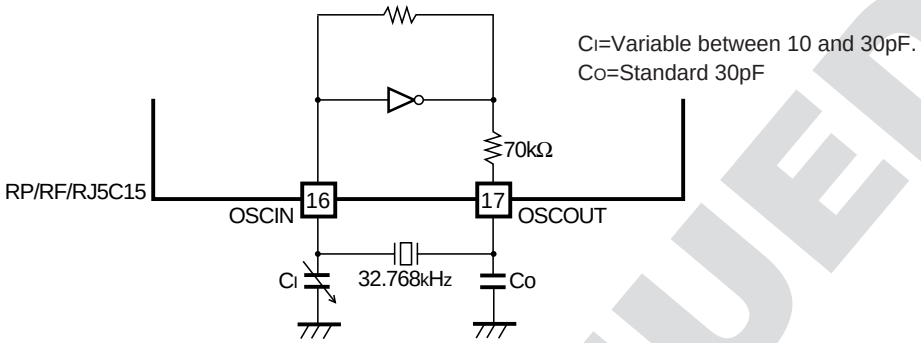
• **Test register (BANK1/0, Address Eh)**

Register used for LSI inspection. Recommended setting is (D_3, D_2, D_1, D_0)=(0, 0, 0, 0)

*) Addresses 0h to Dh are applicable both for Read and Write.
*) Addresses Eh to Fh are applicable only for Write.

OSCILLATOR CIRCUIT

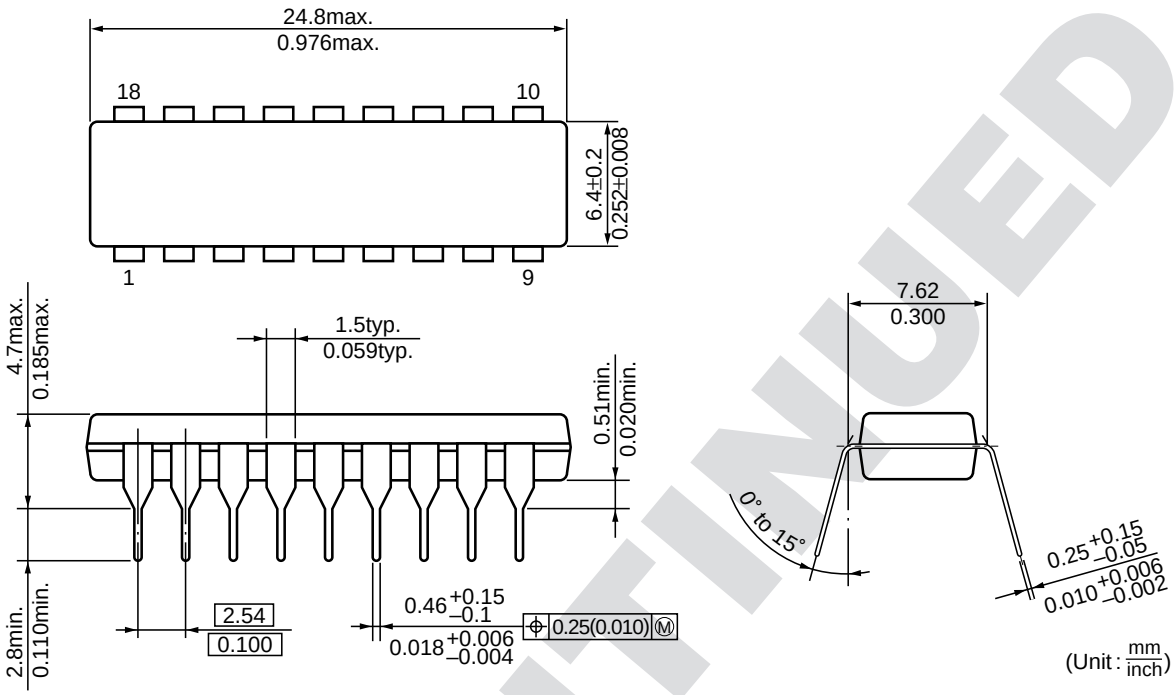
Since this circuit includes an output ballast resistor (≒70k), no external device is necessary.



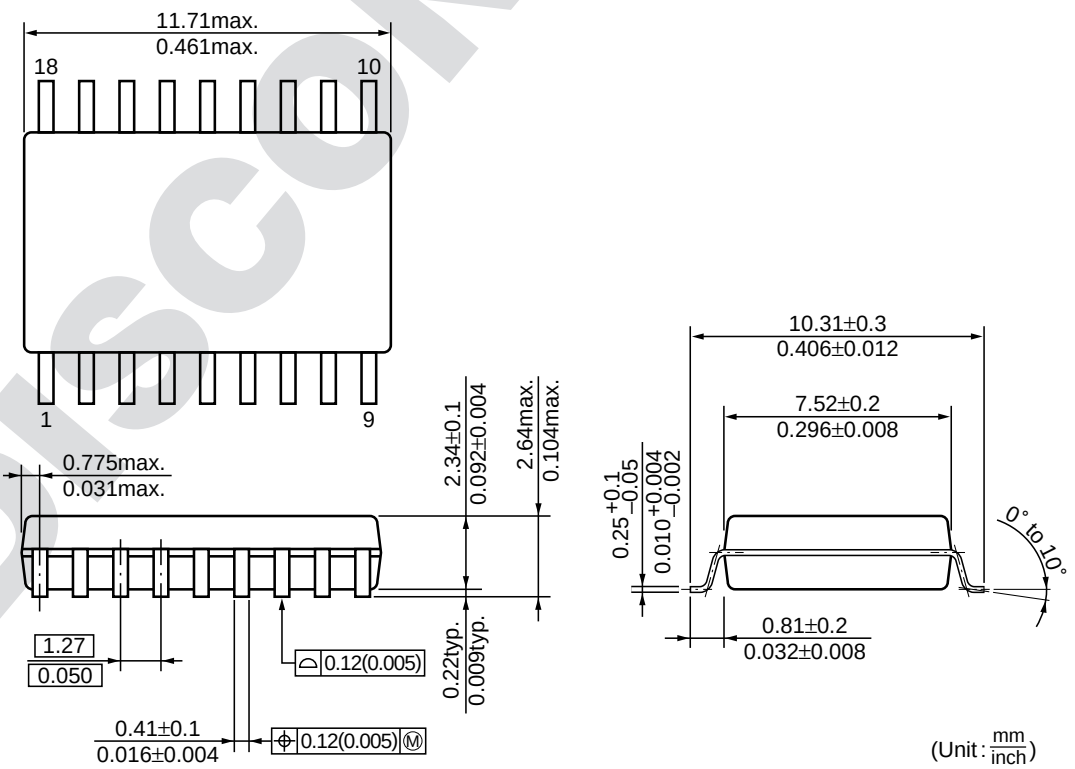
*) Values of CI and CO are for reference only.
*) In the RJ5C15, the OSCIN is 26pin and the OSCOUT is 27pin.

PACKAGE DIMENSIONS

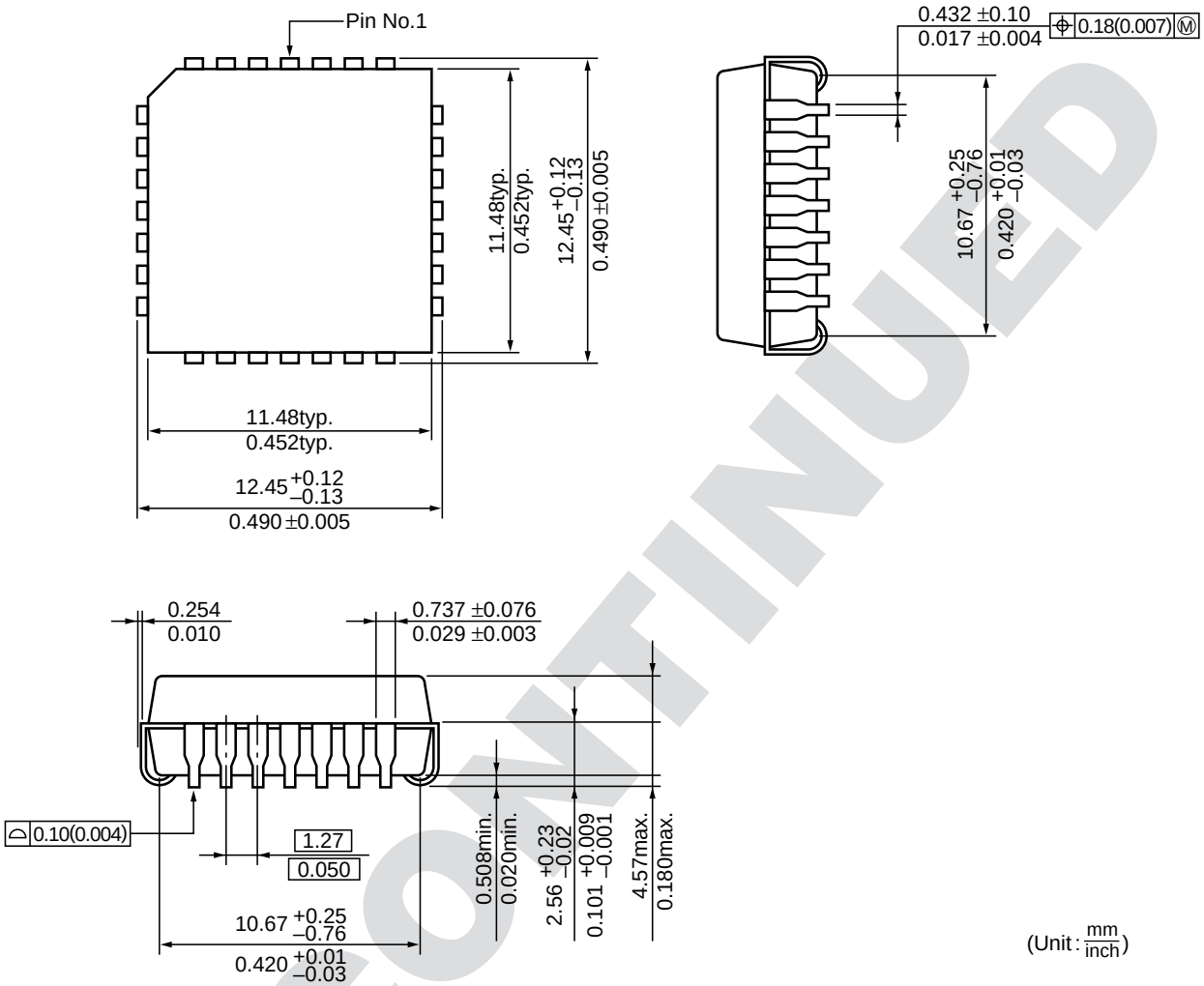
• RP5C15 (18pin DIP)



• RF5C15 (18pin SOP)



• RJ5C15 (24pin PLCC)



(Unit : mm / inch)

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June 1995

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