

# OKI Semiconductor

**FEDL6190B-01**

Issue Date: Mar. 3, 2005

## ML6190B

Longwave Time Code RF Receiver LSI

### GENERAL DESCRIPTION

The ML6190B receives and detects standard low-frequency radio waves and outputs time codes indicating time and calendar information as digital signals. Using the time codes allows clocks built in various devices to be corrected automatically. The ML6190B is provided with a built-in antenna switch to allow reception of two radio frequencies. A CMOS amplifier circuit, which has extremely high impedance input, can capture antenna output signal voltage effectively, so it can have higher radio wave sensitivity than a bipolar amplifier circuit.

### Features

- High sensitivity (1.0  $\mu$ Vrms typ.)
- Low supply current (17  $\mu$ A typ.)
- Low standby current (0.01  $\mu$ A max.)
- Low voltage drive ( $V_{DD} = 1.1$  V to 3.6 V)
- Built-in antenna switch (frequency switching)

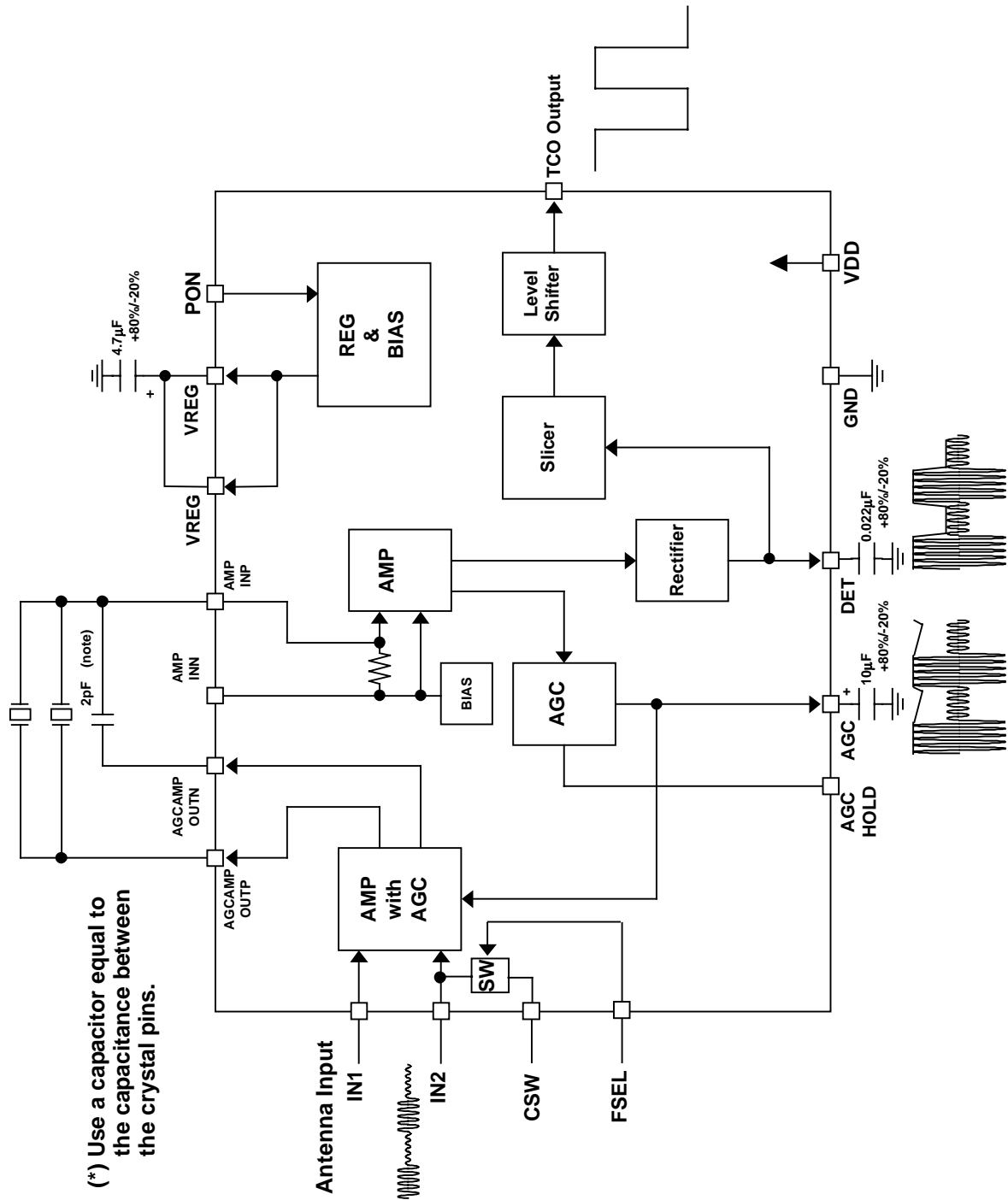
### Functions

- RF amplifier
- AGC circuit
- Rectifier
- Slicer
- Time code output
- Antenna switch

### Package

20-pin SSOP (SSOP20-P-44-0.65-K) (ML6190BMB)

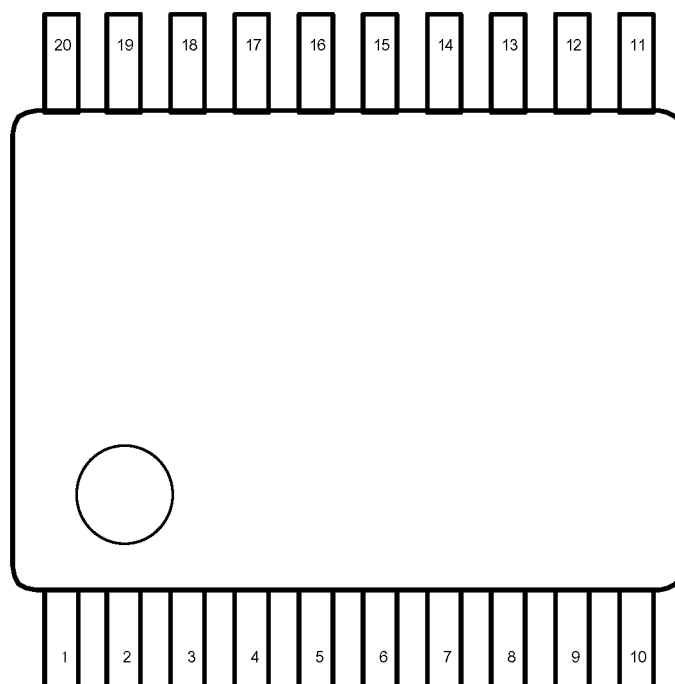
**BLOCK DIAGRAM**



**PIN SPECIFICATIONS**

## • Package

20-pin SSOP (0.65 mm pitch)



## • Pin configuration

Pin	Symbol	Function	Pin	Symbol	Function
1	VREG	Regulator output pin	11	AMPINP	AMP input pin
2	VDD	External power supply pin	12	AMPINN	AMP input pin
3	GND	Ground pin	13	AGCAMPOUTN	AGCAMP output pin
4	FSEL	Antenna switch control pin	14	AGCAMPOUTP	AGCAMP output pin
5	PON	Power-on input pin	15	GND	Ground pin
6	TCO	Time code output pin	16	VREG	Regulator output pin
7	AGC_HOLD	AGC hold input pin	17	GND	Ground pin
8	AGC	AGC pin for external capacitor	18	CSW	Antenna input pin
9	DET	DET pin for external capacitor	19	IN2	Antenna input pin
10	GND	Ground pin	20	IN1	Antenna input pin

- Pin descriptions

Pin	Symbol	I/O	Description
1	VREG	—	Regulator output pin Connect a 4.7 $\mu$ F capacitor between this pin and the GND pin. Either polar or non-polar capacitors can be used. When using polar capacitors, connect them as shown in the block diagram. This pin is connected to pin 16 internally but should also be connected externally.
2	VDD	—	External power supply pin
3	GND	—	Ground pin
4	FSEL	I	Antenna switch control pin
5	PON	O	Power-on input pin “H”: Normal operation “L”: Standby operation
6	TCO	I	Time code output pin The “H” output for the large amplitude signal, the “L” output for the small amplitude signal, and “H” output in the standby state.
7	AGC_HOLD	—	AGC hold input pin “H”: AGC operation “L”: AGC hold operation
8	AGC	—	AGC pin for an external capacitor Connect a 10 $\mu$ F capacitor between this pin and the GND pin. Either polar or non-polar capacitors can be used. When using polar capacitors, connect them as shown in the block diagram.
9	DET		DET pin for an external capacitor Connect a 0.022 $\mu$ F capacitor between this pin and the GND pin.
10	GND	—	Ground pin
11	AMPINP	I	AMP input pin
12	AMPINN	I	AMP input pin Leave this pin open.
13	AGCAMPOUTN	O	Output pin for AMP with AGC
14	AGCAMPOUTP	O	Output pin for AMP with AGC
15	GND	—	Ground pin
16	VREG	—	Regulator output pin This pin is connected to pin 1 internally but should also be connected externally.
17	GND	—	Ground pin
18	CSW	I	Antenna input pin
19	IN2	I	Antenna input pin
20	IN1	I	Antenna input pin

## RADIO WAVE RECEIVING IC SPECIFICATIONS

### Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Maximum supply voltage	$V_{DD}$	$T_a = 25^\circ\text{C}$	-0.3 to +3.8	V
Input voltage	$V_{IN}$		-0.3 to $V_{DD}+0.3$	V
Operating temperature*	$T_{OP}$	—	-40 to +85	$^\circ\text{C}$
Storage temperature	$T_{STG}$	—	-55 to +125	$^\circ\text{C}$

\*: The temperature that does not cause permanent damage to the device (Performance may not be guaranteed)

### Recommended Operating Conditions

Parameter	Symbol	Condition	Rating	Unit
Operating voltage	$V_{DD}$	—	1.1 to 3.6	V
Operating temperature	$T_{OP}$	—	-25 to +85	$^\circ\text{C}$

### Electrical Characteristics

$V_{DD} = 1.5\text{ V}$ ,  $GND = 0\text{ V}$ ,  $T_a = 25\text{ }^\circ\text{C}$ ,  $f_{IN} = 60\text{ kHz}$ , and modulation factor = 90 %, unless otherwise specified.

#### • DC characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply current	$I_{DD}$	—	—	17	38	$\mu\text{A}$
Standby current	$I_{STB}$	—	—	—	0.01	$\mu\text{A}$

#### • AC characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Voltage sensitivity	$V_{INmin}$	—	—	1.0	—	$\mu\text{Vrms}$
Maximum signal input	$V_{INmax}$	—	100	—	—	$\text{mVrms}$
Input resistance	$R_{in}$	Between IN1 and IN2 pins	2	—	—	$\text{M}\Omega$
		Between AMPINP and AMPINN pins	—	500	—	$\text{k}\Omega$
Input capacitance	$C_{in}$	—	—	—	5	$\text{pF}$
Receiving frequency	$f_{IN}$	—	40	—	100	$\text{kHz}$

#### • TCO output characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Output voltage (high)	$V_{OH}$	—	$V_{DD}-0.1$	—	—	V
Output voltage (low)	$V_{OL}$	—	—	—	0.1	V
Output short current (high)	$I_{OH}$	$V_{DD} = 3.6\text{ V}$ $V_O = 0\text{ V}$	—	-36	—	$\mu\text{A}$
Output short current (low)	$I_{OL}$	$V_{DD} = 3.6\text{ V}$ $V_O = 3.6\text{ V}$	—	36	—	$\mu\text{A}$
Output pulse width (500 ms input)	$T_{500}$	—	400	500	600	ms
Output pulse width (800 ms input)	$T_{800}$	—	700	800	900	ms
Output pulse width (200 ms input)	$T_{200}$	—	100	200	300	ms

- AGC hold characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
AGC_HOLD "H" input voltage	$V_{IH\text{AH}}$	During normal operation	$0.9 \cdot V_{DD}$	—	—	V
AGC_HOLD "L" input voltage	$V_{IL\text{AH}}$	During AGC hold	—	—	$0.1 \cdot V_{DD}$	V
AGC_HOLD "H" input current	$ I_{IH\text{AH}} $	$V_I = V_{DD}$	—	0.01	—	$\mu\text{A}$
AGC_HOLD "L" input current	$ I_{IL\text{AH}} $	$V_I = 0.0\text{V}$	—	0.01	—	$\mu\text{A}$

- PON characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
PON "H" input voltage	$V_{IH\text{PON}}$	During normal operation	$0.9 \cdot V_{DD}$	—	—	V
PON "L" input voltage	$V_{IL\text{PON}}$	During standby mode	—	—	$0.1 \cdot V_{DD}$	V
PON "H" input current	$ I_{IH\text{PON}} $	$V_I = V_{DD}$	—	0.01	—	$\mu\text{A}$
PON "L" input current	$ I_{IL\text{PON}} $	$V_I = 0.0\text{V}$	—	0.01	—	$\mu\text{A}$

- FSEL characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
FSEL "H" input voltage	$V_{IH\text{FSEL}}$	Antenna switch ON	$0.9 \cdot V_{DD}$	—	—	V
FSEL "L" input voltage	$V_{IL\text{FSEL}}$	Antenna switch OFF	—	—	$0.1 \cdot V_{DD}$	V
FSEL "H" input current	$ I_{IH\text{FSEL}} $	$V_I = V_{DD}$	—	0.01	—	$\mu\text{A}$
FSEL "L" input current	$ I_{IL\text{FSEL}} $	$V_I = 0.0\text{V}$	—	0.01	—	$\mu\text{A}$
Switching ON resistance	$R_{SWH}$	HSEL = "H"	350	—	—	$\text{k}\Omega$
Switching OFF resistance	$R_{SWL}$	FSEL = "L"	—	20	100	$\Omega$

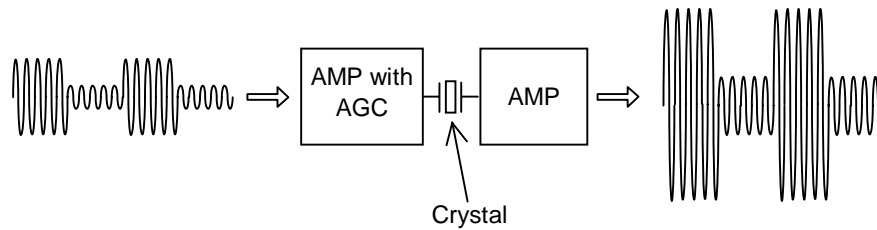
- Delay characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
AGC setup time	$T_{AGC}$	At the time of PON	—	3	—	sec
Response delay	$T_{TCO}$	Phase delay relative to input signal	—	50	—	ms

**DESCRIPTION OF EACH BLOCK**

**(1) AMP Block**

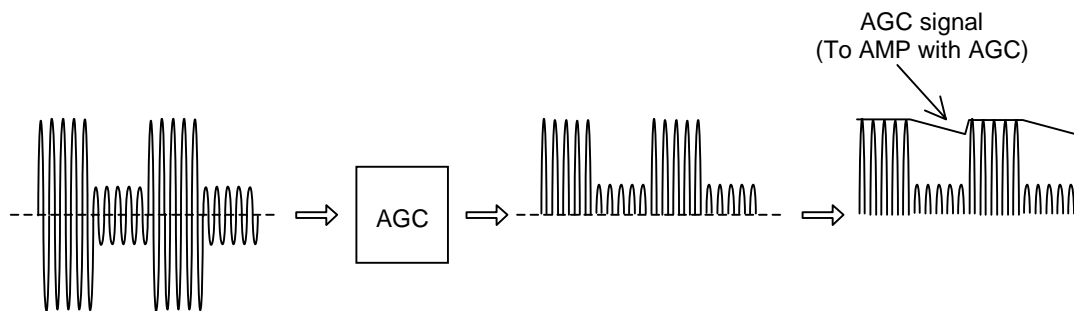
Radio waves received by the antenna will be amplified by AMP with AGC. Signals output from AMP with AGC will go through an external quartz resonator, which serves as a band-pass filter, and will be amplified again at AMP.



**(2) AGC Block**

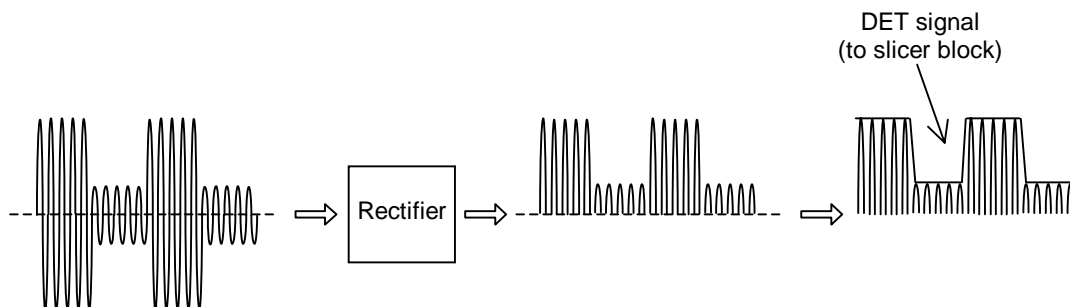
Output signals from AMP will be input to the AGC block and the rectifier block. After signals are input to the AGC block, their high side peak amplitudes are detected. As AGC signals, they will be fed back to AMP with AGC.

The AGC block has the AGC hold function. When the AGC hold signal is "H," the block performs the regular AGC operation. The AGC block performs the AGC hold operation when the AGC hold signal is "L."



**(3) Rectifier Block**

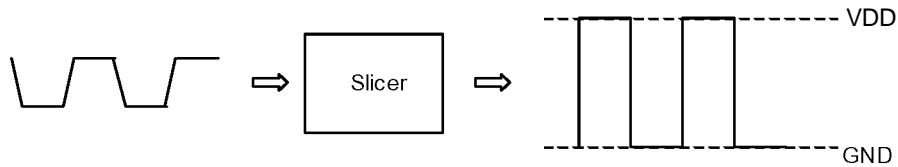
After signals are input to the rectifier block, their high side peak amplitudes are detected. As DET signals, they will be transferred to the slicer block.



## (4) Slicer Block

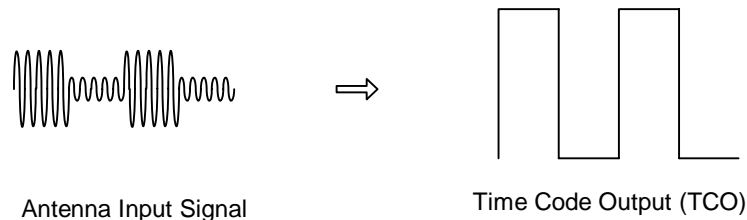
Signals output from the rectifier block are input to the slicer block and will be shaped to  $V_{DD}$  as "1" and GND as "0". Then, these outputs will be output as time codes (TCO).

This LSI has the standby function. When the PON signal is "H," the LSI will perform the regular operation. When the PON signal is "L," the LSI will be in standby state. The TCO during the standby state is "H."



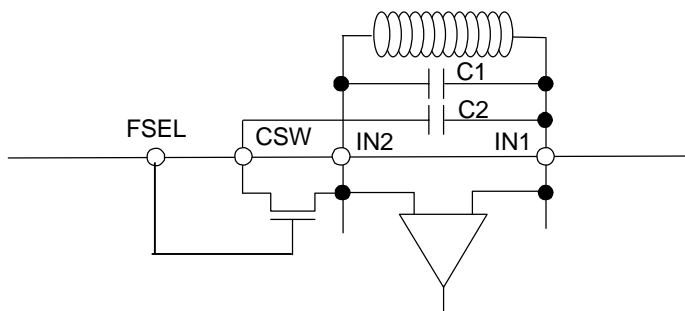
## (5) Time Code Output

The time code output (TCO) of the ML6190B is in phase with actual time codes input from the antenna. A "H" level is output for the large amplitude signal and a "L" level is output for the small amplitude signal.



## (6) Connecting the Antenna

The ML6190B has a built-in antenna switch to allow reception of two receive frequencies. When receiving only one frequency, connect both the antenna and C1 across IN1 and IN2. When receiving two frequencies, add C2 across CSW and IN1 to enable frequency switching.

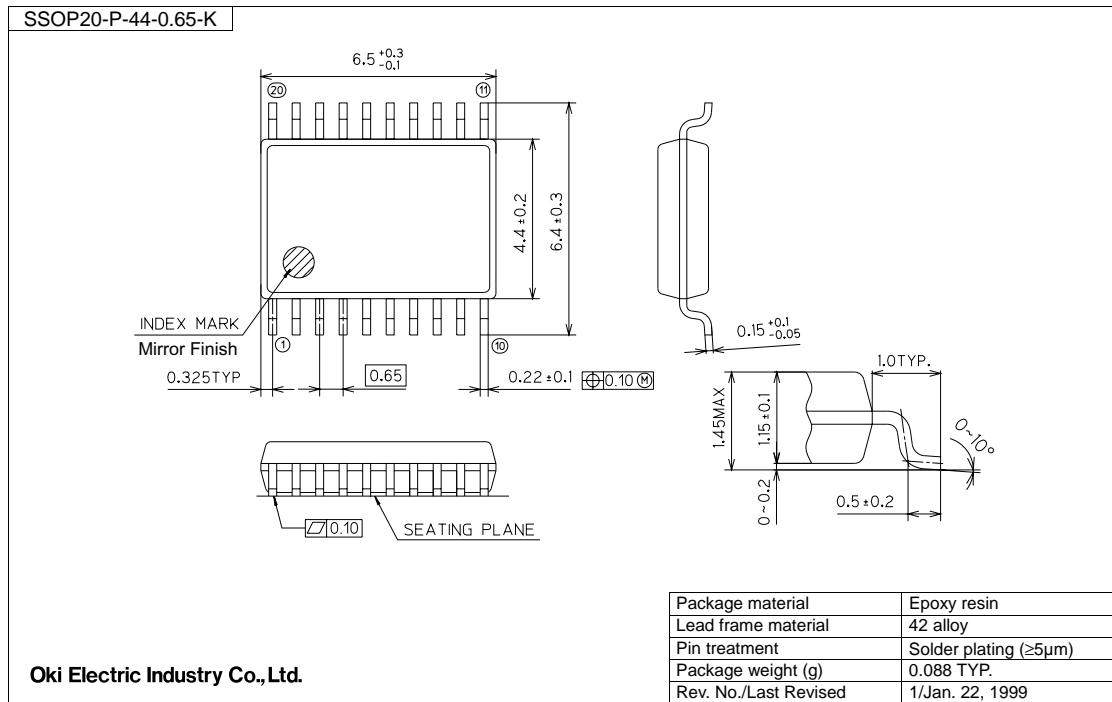


40 kHz/60 kHz Antenna Connection Example



**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	
PEDL6190B-01	Jan. 7, 2005	–	–	Preliminary edition 1
FEDL6190B-01	Mar. 3, 2005	–	–	Final edition 1
		1	1	Modified contents in the "GENERAL DESCRIPTION" Section.
		2	2	Modified the block diagram and eliminated "Note".
		4	4	Partially added contents of the descriptions of Pins 1, 8, and 16.
		5, 6	5, 6	Partially changed contents in the "Electrical characteristics" Section.

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