



**THE DATASHEET OF  
98ULPA877AHILFT**





## 1.8V Low-Power Wide-Range Frequency Clock Driver

### Recommended Application:

- DDR2 Memory Modules / Zero Delay Board Fan Out
- Provides complete DDR2 DIMM logic solution

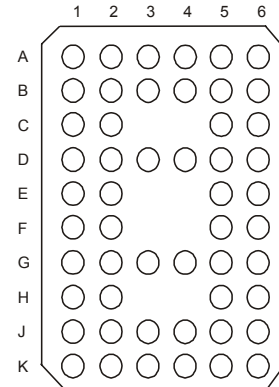
### Product Description/Features:

- Low skew, low jitter PLL clock driver
- 1 to 10 differential clock distribution (SSTL\_18)
- Feedback pins for input to output synchronization
- Spread Spectrum tolerant inputs
- Auto PD when input signal is at a certain logic state

### Switching Characteristics:

- Period jitter: 40ps (DDR2-400/533)  
30ps (DDR2-667/800)
- Half-period jitter: 60ps (DDR2-400/533)  
50ps (DDR2-667/800)
- OUTPUT - OUTPUT skew: 40ps (DDR2-400/533)  
30ps (DDR2-667/800)
- CYCLE - CYCLE jitter 40ps

### Pin Configuration

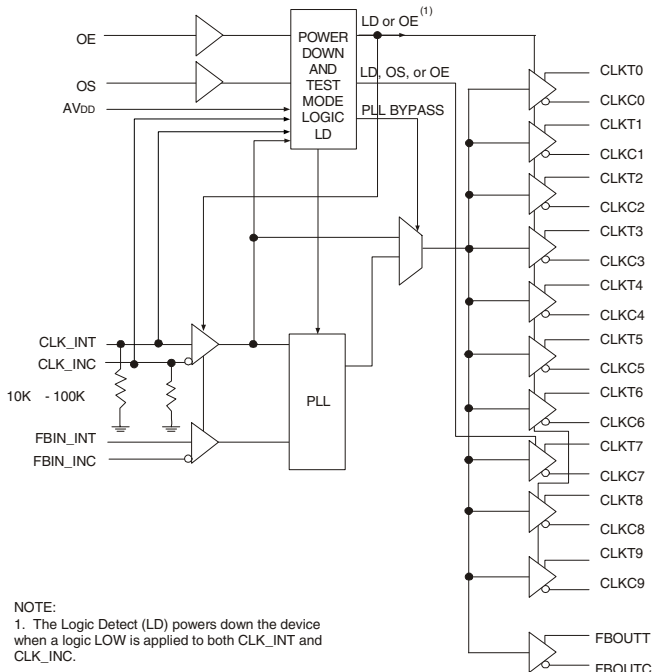


**52-Ball BGA**

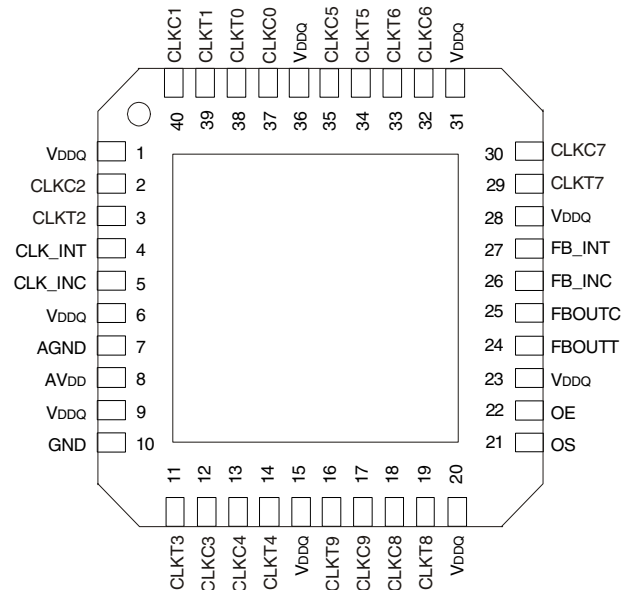
**Top View**

|   | 1       | 2     | 3     | 4     | 5     | 6       |
|---|---------|-------|-------|-------|-------|---------|
| A | CLKT1   | CLKT0 | CLKC0 | CLKC5 | CLKT5 | CLKT6   |
| B | CLKC1   | GND   | GND   | GND   | GND   | CLKC6   |
| C | CLKC2   | GND   | NB    | NB    | GND   | CLKC7   |
| D | CLKT2   | VDDQ  | VDDQ  | VDDQ  | OS    | CLKT7   |
| E | CLK_INT | VDDQ  | NB    | NB    | VDDQ  | FB_INT  |
| F | CLK_INC | VDDQ  | NB    | NB    | OE    | FB_INC  |
| G | AGND    | VDDQ  | VDDQ  | VDDQ  | VDDQ  | FB_OUTC |
| H | AVDD    | GND   | NB    | NB    | GND   | FB_OUTT |
| J | CLKT3   | GND   | GND   | GND   | GND   | CLKT8   |
| K | CLKC3   | CLKC4 | CLKT4 | CLKT9 | CLKC9 | CLKC8   |

### Block Diagram



NOTE:  
1. The Logic Detect (LD) powers down the device when a logic LOW is applied to both CLK\_INT and CLK\_INC.



**40-Pin MLF**

## Pin Descriptions

| Terminal Name    | Description   | Electrical Characteristics |
|------------------|---|----------------------------|
| AGND             | Analog Ground   | Ground                     |
| AV <sub>DD</sub> | Analog power  | 1.8 V nominal              |
| CLK_INT          | Clock input with a (10K-100K Ohm) pulldown resistor               | Differential input         |
| CLK_INC          | Complementary clock input with a (10K-100K Ohm) pulldown resistor | Differential input         |
| FB_INT           | Feedback clock input  | Differential input         |
| FB_INC           | Complementary feedback clock input                                | Differential input         |
| FB_OUTT          | Feedback clock output   | Differential output        |
| FB_OUTC          | Complementary feedback clock output                               | Differential output        |
| OE               | Output Enable (Asynchronous)                                      | LVC MOS input              |
| OS               | Output Select (tied to GND or V <sub>DDQ</sub> )                  | LVC MOS input              |
| GND              | Ground  | Ground                     |
| V <sub>DDQ</sub> | Logic and output power  | 1.8V nominal               |
| CLKT[0:9]        | Clock outputs   | Differential outputs       |
| CLKC[0:9]        | Complementary clock outputs                                       | Differential outputs       |
| NB               | No ball   |                            |

The PLL clock buffer, **ICS98ULPA877A**, is designed for a V<sub>DDQ</sub> of 1.8 V, a AV<sub>DD</sub> of 1.8 V and differential data input and output levels. Package options include a plastic 52-ball VFBGA and a 40-pin MLF.

**ICS98ULPA877A** is a zero delay buffer that distributes a differential clock input pair (CLK\_INT, CLK\_INC) to ten differential pair of clock outputs (CLKT[0:9], CLKC[0:9]) and one differential pair feedback clock outputs (FB\_OUTT, FB\_OUTC). The clock outputs are controlled by the input clocks (CLK\_INT, CLK\_INC), the feedback clocks (FB\_INT, FB\_INC), the LVC MOS program pins (OE, OS) and the Analog Power input (AV<sub>DD</sub>). When OE is low, the outputs (except FB\_OUTT/FB\_OUTC) are disabled while the internal PLL continues to maintain its locked-in frequency. OS (Output Select) is a program pin that must be tied to GND or V<sub>DDQ</sub>. When OS is high, OE will function as described above. When OS is low, OE has no effect on CLK7/CLKC7 (they are free running in addition to FB\_OUTT/FB\_OUTC). When AV<sub>DD</sub> is grounded, the PLL is turned off and bypassed for test purposes.

When both clock signals (CLK\_INT, CLK\_INC) are logic low, the device will enter a low power mode. An input logic detection circuit on the differential inputs, independent from the input buffers, will detect the logic low level and perform a low power state where all outputs, the feedback and the PLL are OFF. When the inputs transition from both being logic low to being differential signals, the PLL will be turned back on, the inputs and outputs will be enabled and the PLL will obtain phase lock between the feedback clock pair (FB\_INT, FB\_INC) and the input clock pair (CLK\_INT, CLK\_INC) within the specified stabilization time t<sub>STAB</sub>.

The PLL in **ICS98ULPA877A** clock driver uses the input clocks (CLK\_INT, CLK\_INC) and the feedback clocks (FB\_INT, FB\_INC) to provide high-performance, low-skew, low-jitter output differential clocks (CLKT[0:9], CLKC[0:9]). **ICS98ULPA877A** is also able to track Spread Spectrum Clocking (SSC) for reduced EMI.

ICS98ULPA877A is available in Commercial Temperature Range (0°C to 70°C) and Industrial Temperature Range (-40°C to +85°C). See Ordering Information for details

## Function Table

| Inputs    |    |    |         |         | Outputs                   |                           |         |         | PLL          |
|-----------|----|----|---------|---------|---------------------------|---------------------------|---------|---------|--------------|
| AVDD      | OE | OS | CLK_INT | CLK_INC | CLKT                      | CLKC                      | FB_OUTT | FB_OUTC |              |
| GND       | H  | X  | L       | H       | L                         | H                         | L       | H       | Bypassed/Off |
| GND       | H  | X  | H       | L       | H                         | L                         | H       | L       | Bypassed/Off |
| GND       | L  | H  | L       | H       | *L(Z)                     | *L(Z)                     | L       | H       | Bypassed/Off |
| GND       | L  | L  | H       | L       | *L(Z),<br>CLKT7<br>active | *L(Z),<br>CLKC7<br>active | H       | L       | Bypassed/Off |
| 1.8V(nom) | L  | H  | L       | H       | *L(Z)                     | *L(Z)                     | L       | H       | On           |
| 1.8V(nom) | L  | L  | H       | L       | *L(Z),<br>CLKT7<br>active | *L(Z),<br>CLKC7<br>active | H       | L       | On           |
| 1.8V(nom) | H  | X  | L       | H       | L                         | H                         | L       | H       | On           |
| 1.8V(nom) | H  | X  | H       | L       | H                         | L                         | H       | L       | On           |
| 1.8V(nom) | X  | X  | L       | L       | *L(Z)                     | *L(Z)                     | *L(Z)   | *L(Z)   | Off          |
| 1.8V(nom) | X  | X  | H       | H       | Reserved                  |                           |         |         |              |

\*L(Z) means the outputs are disabled to a low stated meeting the I<sub>ODL</sub> limit.

## Absolute Maximum Ratings

|                               |                                       |
|-------------------------------|---------------------------------------|
| Supply Voltage (VDDQ & AVDD)  | -0.5V to 2.5V                         |
| Logic Inputs                  | GND - 0.5V to V <sub>DDQ</sub> + 0.5V |
| Ambient Operating Temperature | -40°C to +85°C                        |
| Storage Temperature           | -65°C to +150°C                       |

Stresses above those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These ratings are stress specifications only and functional operation of the device at these or any other conditions above those listed in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

## Electrical Characteristics - Input/Supply/Common Output Parameters

Commercial: TA = 0°C - 70°C; Industrial: TA = -40°C - +85°C;  
 Supply Voltage AVDDQ, VDDQ = 1.8 V +/- 0.1V (unless otherwise stated)

| PARAMETER                                     | SYMBOL             | CONDITIONS                                      | MIN                    | TYP  | MAX  | UNITS |
|---|--------------------|---|------------------------|------|------|-------|
| Input High Current<br>(CLK_INT, CLK_INC)      | I <sub>IH</sub>    | V <sub>I</sub> = V <sub>DDQ</sub> or GND        |                        |      | ±250 | μA    |
| Input Low Current (OE,<br>OS, FB_INT, FB_INC) | I <sub>IL</sub>    | V <sub>I</sub> = V <sub>DDQ</sub> or GND        |                        |      | ±10  | μA    |
| Output Disabled Low<br>Current                | I <sub>ODL</sub>   | OE = L, V <sub>ODL</sub> = 100mV                | 100                    |      |      | μA    |
| Operating Supply<br>Current                   | I <sub>DD1.8</sub> | C <sub>L</sub> = 0pf @ 410MHz                   |                        |      | 300  | mA    |
|   | I <sub>DDL</sub>   | C <sub>L</sub> = 0pf                            |                        |      | 500  | μA    |
| Input Clamp Voltage                           | V <sub>IK</sub>    | V <sub>DDQ</sub> = 1.7V I <sub>in</sub> = -18mA |                        |      | -1.2 | V     |
| High-level output voltage                     | V <sub>OH</sub>    | I <sub>OH</sub> = -100 μA                       | V <sub>DDQ</sub> - 0.2 |      |      | V     |
|   |                    | I <sub>OH</sub> = -9 mA                         | 1.1                    | 1.45 |      | V     |
| Low-level output voltage                      | V <sub>OL</sub>    | I <sub>OL</sub> = 100 μA                        |                        | 0.25 | 0.10 | V     |
|   |                    | I <sub>OL</sub> = 9 mA                          |                        |      | 0.6  | V     |
| Input Capacitance <sup>1</sup>                | C <sub>IN</sub>    | V <sub>I</sub> = GND or V <sub>DDQ</sub>        | 2                      |      | 3    | pF    |
| Output Capacitance <sup>1</sup>               | C <sub>OUT</sub>   | V <sub>OUT</sub> = GND or V <sub>DDQ</sub>      | 2                      |      | 3    | pF    |

<sup>1</sup>Guaranteed by design, not 100% tested in production.

### Recommended Operating Condition (see note1)

Commercial: TA = 0°C - 70°C; Industrial: TA = -40°C - +85°C;

Supply Voltage AVDDQ, VDDQ = 1.8 V +/- 0.1V (unless otherwise stated)

| PARAMETER                                  | SYMBOL                              | CONDITIONS                            | MIN                        | TYP                | MAX                        | UNITS |
|--|-------------------------------------|---------------------------------------|----------------------------|--------------------|----------------------------|-------|
| Supply Voltage                             | V <sub>DDQ</sub> , A <sub>VDD</sub> |                                       | 1.7                        | 1.8                | 1.9                        | V     |
| Low level input voltage                    | V <sub>IL</sub>                     | CLK_INT, CLK_INC, FB_INC, FB_INT      |                            |                    | 0.35 x V <sub>DDQ</sub>    | V     |
|  |                                     | OE, OS                                |                            |                    | 0.35 x V <sub>DDQ</sub>    | V     |
| High level input voltage                   | V <sub>IH</sub>                     | CLK_INT, CLK_INC, FB_INC, FB_INT      | 0.65 x V <sub>DDQ</sub>    |                    |                            | V     |
|  |                                     | OE, OS                                | 0.65 x V <sub>DDQ</sub>    |                    |                            | V     |
| DC input signal voltage (note 2)           | V <sub>IN</sub>                     |                                       | -0.3                       |                    | V <sub>DDQ</sub> + 0.3     | V     |
| Differential input signal voltage (note 3) | V <sub>ID</sub>                     | DC - CLK_INT, CLK_INC, FB_INC, FB_INT | 0.3                        |                    | V <sub>DDQ</sub> + 0.4     | V     |
|  |                                     | AC - CLK_INT, CLK_INC, FB_INC, FB_INT | 0.6                        |                    | V <sub>DDQ</sub> + 0.4     | V     |
| Output differential cross-voltage (note 4) | V <sub>OX</sub>                     |                                       | V <sub>DDQ</sub> /2 - 0.10 |                    | V <sub>DDQ</sub> /2 + 0.10 | V     |
| Input differential cross-voltage (note 4)  | V <sub>IX</sub>                     |                                       | V <sub>DDQ</sub> /2 - 0.15 | V <sub>DD</sub> /2 | V <sub>DDQ</sub> /2 + 0.15 | V     |
| High level output current                  | I <sub>OH</sub>                     |                                       |                            |                    | -9                         | mA    |
| Low level output current                   | I <sub>OL</sub>                     |                                       |                            |                    | 9                          | mA    |
| Operating free-air temperature             | T <sub>A</sub>                      |                                       | -40                        |                    | 85                         | °C    |

#### Notes:

- Unused inputs must be held high or low to prevent them from floating.
- DC input signal voltage specifies the allowable DC execution of differential input.
- Differential inputs signal voltages specifies the differential voltage [VTR-VCP] required for switching, where VTR is the true input level and VCP is the complementary input level.
- Differential cross-point voltage is expected to track variations of V<sub>DDQ</sub> and is the voltage at which the differential signal must be crossing.

## Timing Requirements

Commercial: TA = 0°C - 70°C; Industrial: TA = -40°C - +85°C;

Supply Voltage AVDDQ, VDDQ = 1.8 V +/- 0.1V (unless otherwise stated)

| PARAMETER                   | SYMBOL              | CONDITIONS       | MIN | MAX | UNITS |
|-----------------------------|---------------------|------------------|-----|-----|-------|
| Max clock frequency         | freq <sub>op</sub>  | 1.8V±0.1V @ 25°C | 95  | 410 | MHz   |
| Application Frequency Range | freq <sub>App</sub> | 1.8V±0.1V @ 25°C | 160 | 410 | MHz   |
| Input clock duty cycle      | d <sub>tin</sub>    |                  | 40  | 60  | %     |
| CLK stabilization           | T <sub>STAB</sub>   |                  |     | 15  | µs    |

NOTE: The PLL must be able to handle spread spectrum induced skew.

NOTE: Operating clock frequency indicates a range over which the PLL must be able to lock, but in which it is not required to meet the other timing parameters. (Used for low speed system debug.)

NOTE: Application clock frequency indicates a range over which the PLL must meet all timing parameters.

NOTE: Stabilization time is the time required for the integrated PLL circuit to obtain phase lock of its feedback signal to its reference signal, within the value specified by the Static Phase Offset ( $t_{\phi}$ ), after power-up. During normal operation, the stabilization time is also the time required for the integrated PLL circuit to obtain phase lock of its feedback signal to its reference signal when CK and CK# go to a logic low state, enter the power-down mode and later return to active operation. CK and CK# may be left floating after they have been driven low for one complete clock cycle.

## Switching Characteristics<sup>1</sup>

Commercial: TA = 0°C - 70°C; Industrial: TA = -40°C - +85°C;

Supply Voltage AVDDQ, VDDQ = 1.8 V +/- 0.1V (unless otherwise stated)

| PARAMETER                                    | SYMBOL          | CONDITION                | (MHz)      | MIN   | TYP  | MAX   | UNITS |
|--|-----------------|--------------------------|------------|-------|------|-------|-------|
| Output enable time                           | $t_{en}$        | OE to any output         | 160 to 410 |       | 4.73 | 8     | ns    |
| Output disable time                          | $t_{dis}$       | OE to any output         |            |       | 5.82 | 8     | ns    |
| Period jitter                                | $t_{jit(per)}$  |                          | 160 to 270 | -40   |      | 40    | ps    |
|  |                 |                          | 271 to 410 | -30   |      | 30    | ps    |
| Half-period jitter                           | $t_{jit(hper)}$ |                          | 160 to 270 | -60   |      | 60    | ps    |
|  |                 |                          | 271 to 410 | -50   |      | 50    | ps    |
| Input slew rate                              | SLr1(i)         | Input Clock              | 160 to 410 | 1     | 2.5  | 4     | v/ns  |
|  |                 | Output Enable (OE), (OS) |            | 0.5   |      |       | v/ns  |
| Output clock slew rate                       | SLr1(o)         |                          | 160 to 410 | 1.5   | 2.5  | 3     | v/ns  |
| Cycle-to-cycle period jitter                 | $t_{jit(cc+)}$  |                          |            | 0     |      | 40    | ps    |
|  | $t_{jit(cc-)}$  |                          |            | 0     |      | -40   | ps    |
| Dynamic Phase Offset                         | $t_{(\phi)dyn}$ |                          | 160 to 270 | -50   |      | 50    | ps    |
|  |                 |                          | 271 to 410 | -20   |      | 20    | ps    |
| Static Phase Offset                          | $t_{SPO}^2$     |                          | 271 to 410 | -50   | 0    | 50    | ps    |
| $t_{jit(per)} + t_{(\phi)dyn} + t_{skew(o)}$ | $\sum_{(su)}$   |                          |            |       |      | 80    | ps    |
| $t_{(\phi)dyn} + t_{skew(o)}$                | $\sum_{(h)}$    |                          |            |       |      | 60    | ps    |
| Output to Output Skew                        | $t_{skew}$      |                          | 160 to 270 |       |      | 40    | ps    |
|  |                 |                          | 271 to 410 |       |      | 30    | ps    |
| SSC modulation frequency                     |                 |                          |            | 30.00 |      | 33    | kHz   |
| SSC clock input frequency deviation          |                 |                          |            | 0.00  |      | -0.50 | %     |
| PLL Loop bandwidth (-3 dB from unity gain)   |                 |                          |            | 2.0   |      |       | MHz   |

### Notes:

1. Switching characteristics guaranteed for application frequency range.
2. Static phase offset shifted by design.

## Parameter Measurement Information

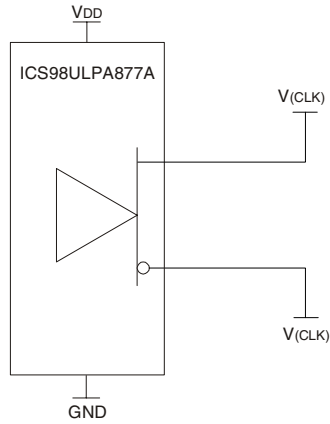


Figure 1: IBIS Model Output Load

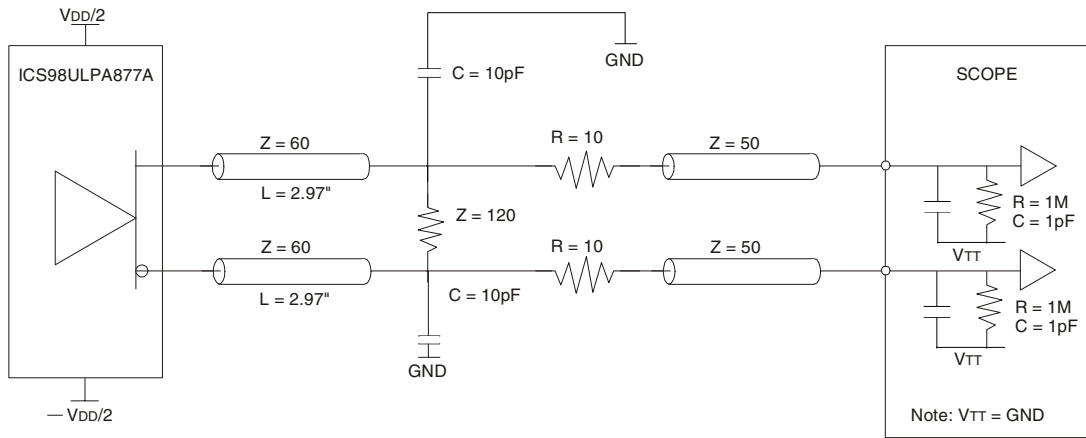


Figure 2: Output Load Test Circuit

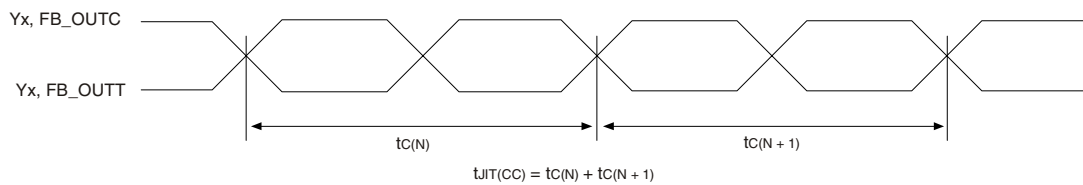


Figure 3: Cycle-to-Cycle Jitter

### Parameter Measurement Information

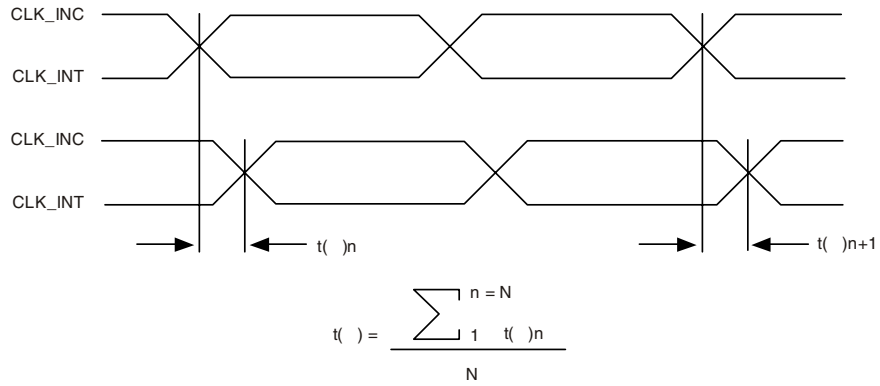


Figure 4: Static Phase Offset

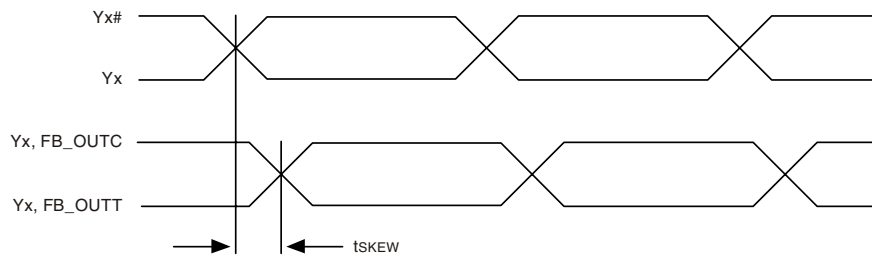


Figure 5: Output Skew

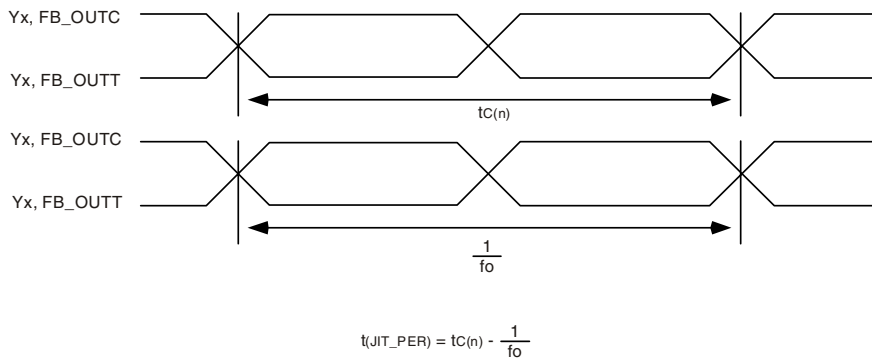
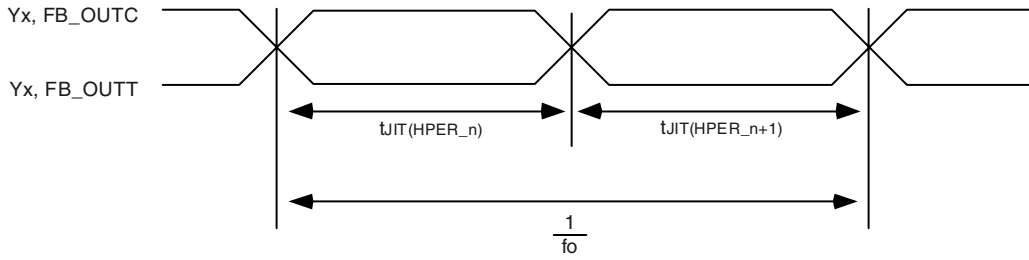


Figure 6: Period Jitter

Parameter Measurement Information



$$t_{JIT}(HPER) = t_{JIT}(HPER_n) - \frac{1}{2xf_o}$$

Figure 7: Half-Period Jitter

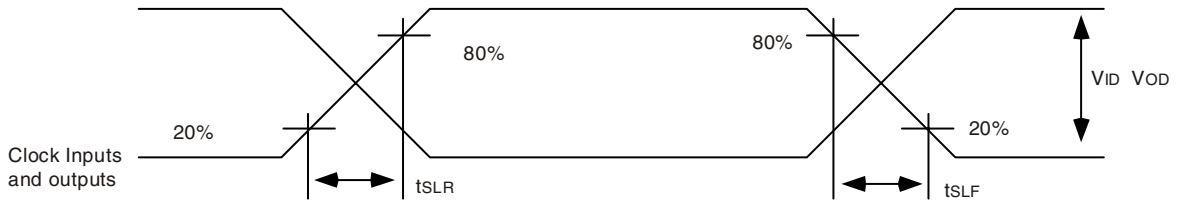


Figure 8: Input and Output Slew Rates

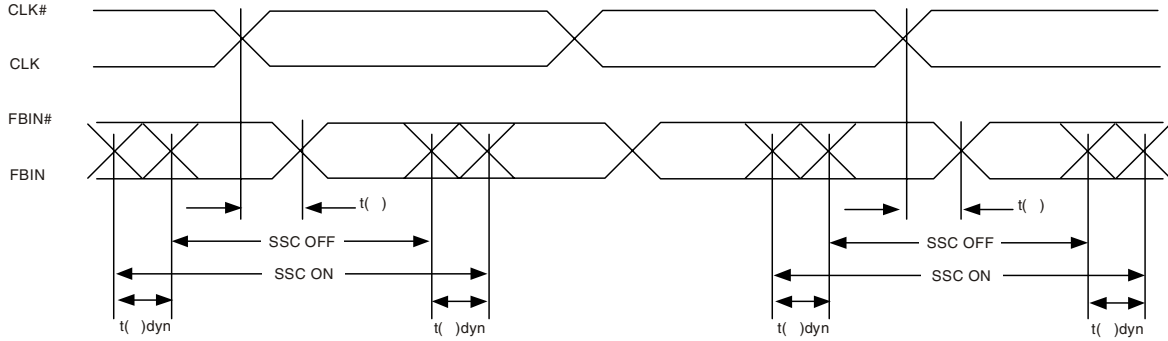


Figure 9: Dynamic Phase Offset

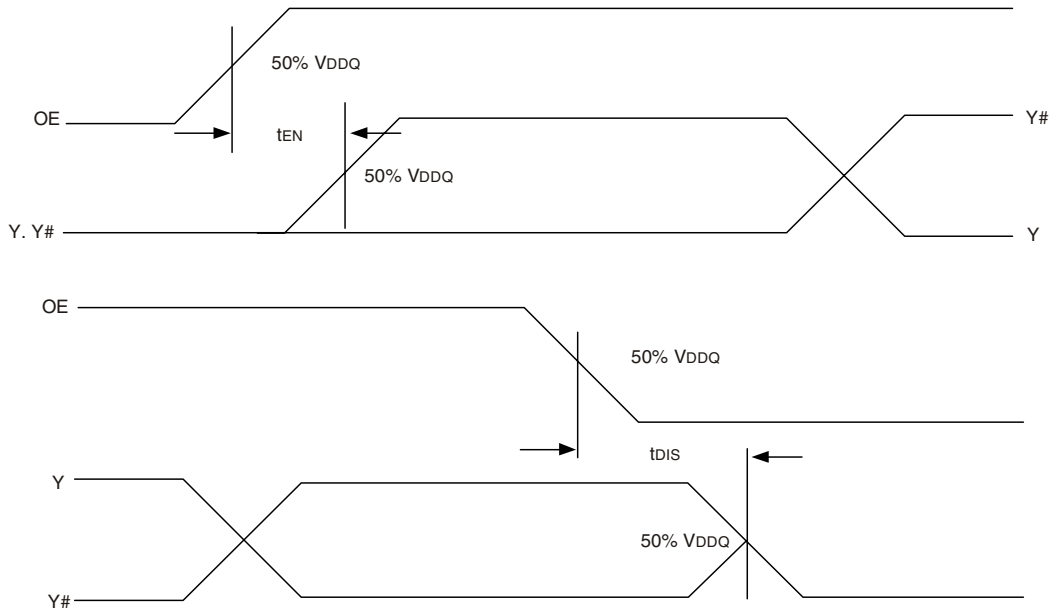


Figure 10: Time Delay Between OE and Clock Output (Y, Y#)

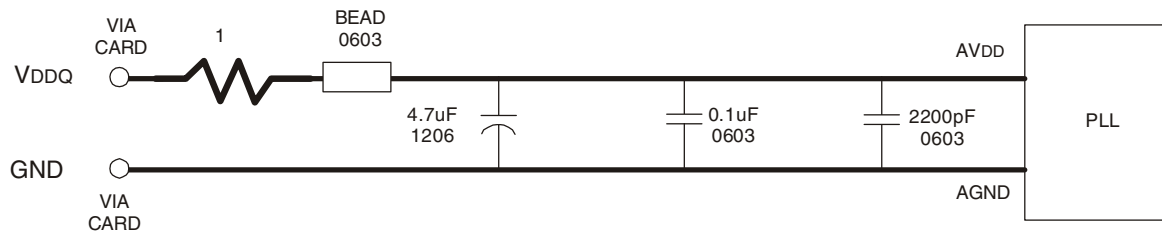
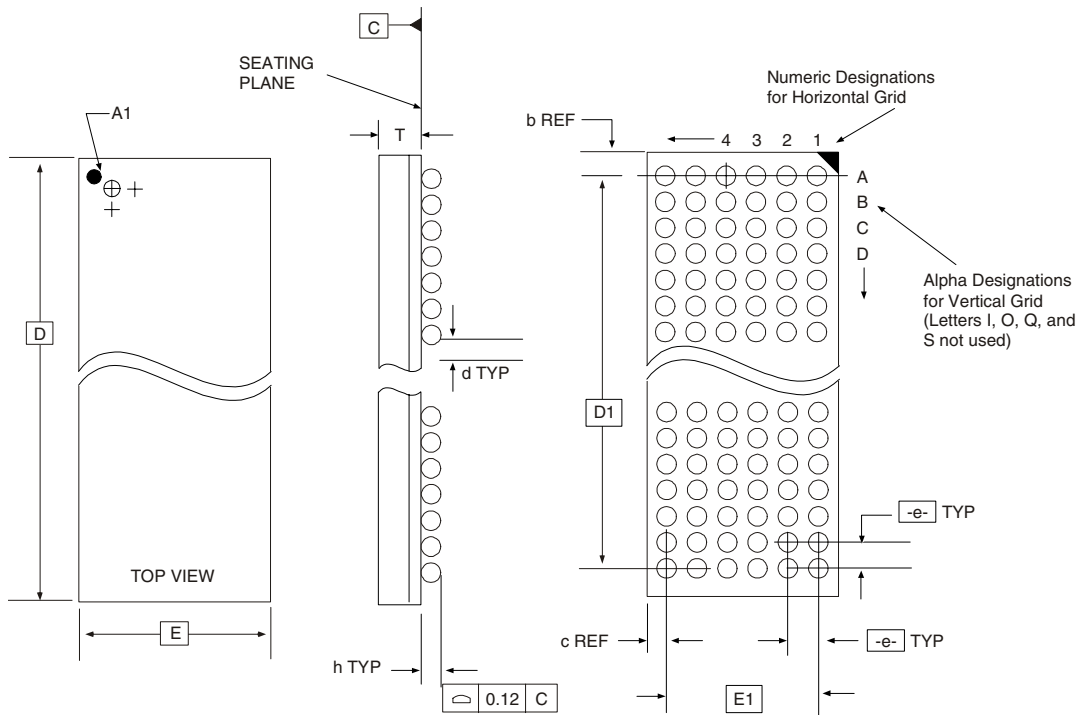


Figure 11. AVDD Filtering

- \*Place the 2200pF capacitors close to the PLL.
- \*Use wide traces for PLL Analog power and GND. Connect PLL and caps to AGND trace and connect trace to one GND via (farthest from PLL).
- \*Recommended bead: Fair-rite P/N 2506036017Y0 or equivalent (0.8 DC max., 600 at 100MHz).



ALL DIMENSIONS IN MILLIMETERS

| D        | E        | T<br>Min/Max | e        | BALL GRID |      | Max.<br>TOTAL | d<br>Min/Max | h<br>Min/Max | D1       | E1       | REF. DIMENSIONS |         |
|----------|----------|--------------|----------|-----------|------|---------------|--------------|--------------|----------|----------|-----------------|---------|
|          |          |              |          | HORIZ     | VERT |               |              |              |          |          | b               | c       |
| 7.00 Bsc | 4.50 Bsc | 0.86/1.00    | 0.65 Bsc | 6         | 10   | 60            | 0.25/0.45    | 0.15/0.31    | 5.85 Bsc | 3.25 Bsc | 0.575           | 0.625** |

Note: Ball grid total indicates maximum ball count for package. Lesser quantity may be used.

\* Source Ref.: JEDEC Publication 95, MO-205\*, MO-225\*\*

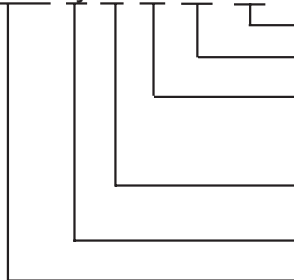
10-0055

## Ordering Information

### 98ULPA877AHLFT

Example:

**XXXX y H z LF T**



**Designation for tape and reel packaging**

**Lead Free, RoHS Compliant (Optional)**

**Temperature Grade**

Blank = 0°C to +70°C (Commercial)

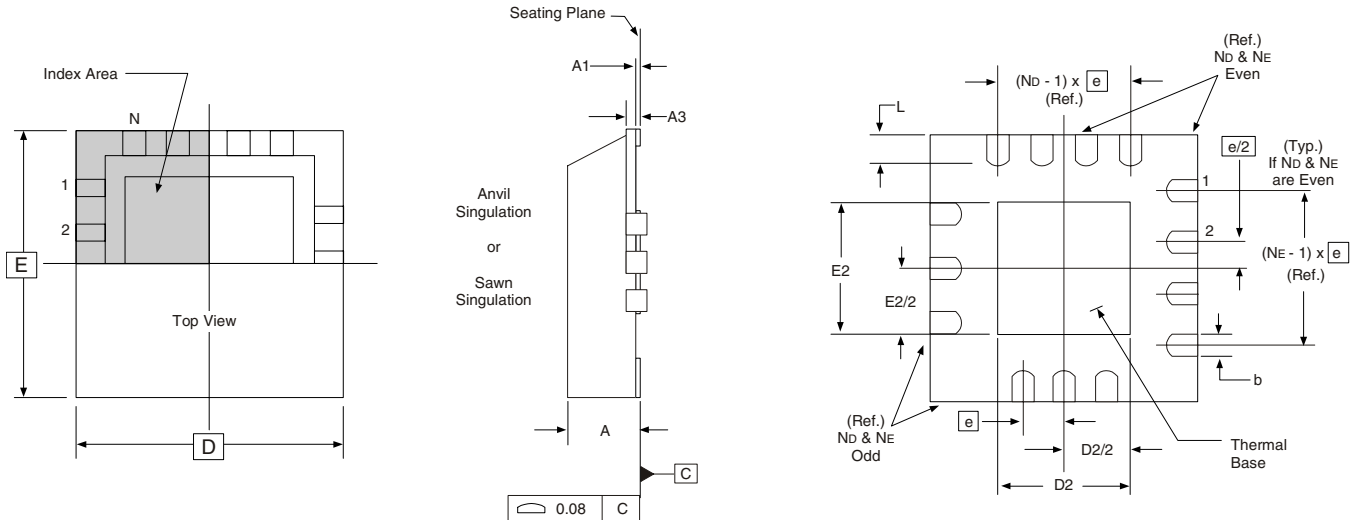
I = -40°C to +85°C (Industrial)

**Package Type**

H = BGA

**Revision Designator** (will not correlate with datasheet revision)

**Device Type**



**THERMALLY ENHANCED, VERY THIN, FINE PITCH  
QUAD FLAT / NO LEAD PLASTIC PACKAGE**

ALL DIMENSIONS IN MILLIMETERS

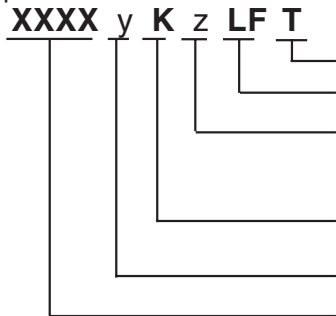
|                |             | SYMBOL | MIN.           | MAX. |
|----------------|-------------|--------|----------------|------|
| N              | 40          |        |                |      |
| N <sub>D</sub> | 10          | A      | 0.80           | 1.00 |
| N <sub>E</sub> | 10          | A1     | 0              | 0.05 |
| D x E BASIC    | 6.00 x 6.00 | A3     | 0.25 Reference |      |
| D2 MIN. / MAX. | 2.75 / 3.05 | b      | 0.18           | 0.30 |
| E2 MIN. / MAX. | 2.75 / 3.05 | e      | 0.50 BASIC     |      |
| L MIN. / MAX.  | 0.30 / 0.50 |        |                |      |

Source Reference: MLF2™ †  
10-0053

**Ordering Information**

**98ULPA877AKLFT**

Example:



**Designation for tape and reel packaging**

**Lead Free, RoHS Compliant (Optional)**

**Temperature Grade**

Blank = 0°C to +70°C (Commercial)

I = -40°C to +85°C (Industrial)

**Package Type**

K = MLF

**Revision Designator (will not correlate with datasheet revision)**

**Device Type**

## IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers who are designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only to develop an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising from your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.01 Jan 2024)

### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

### Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

### Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit [www.renesas.com/contact-us/](http://www.renesas.com/contact-us/).

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

- ⊖ [View 98ULPA877AHILFT on WIN SOURCE](#)
- ⊖ [Renesas Electronics America](#) Information

## Optimize Your Supply Chain with WIN SOURCE Solutions

- ✓ Global Sourcing Solution
- ✓ Obsolete Management
- ✓ Cost Control Management
- ✓ Shortage Management
- ✓ Alternative Solution
- ✓ Excess Inventory Management