



DDR 14-Bit Registered Buffer

Recommended Application:

DDR Memory Modules

Product Features:

- Differential clock signal
- Meets SSTL_2 signal data
- Supports SSTL_2 class I & II specifications
- low-voltage operation
VDD = 2.3V to 2.7V
- 48 pin TSSOP package

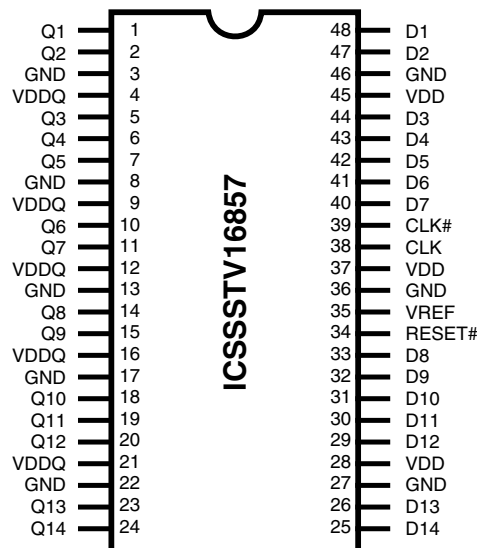
Truth Table¹

| Inputs | | | | Q Outputs |
|--------|---------------|---------------|---------------|-------------------------------|
| RESET# | CLK | CLK# | D | Q |
| L | X or Floating | X or Floating | X or Floating | L |
| H | ↑ | ↓ | H | H |
| H | ↑ | ↓ | L | L |
| H | L or H | L or H | X | Q ₀ ⁽²⁾ |

Notes:

1. H = High Signal Level
L = Low Signal Level
↑ = Transition LOW-to-HIGH
↓ = Transition HIGH -to LOW
X = Irrelevant
2. Output level before the indicated steady state input conditions were established.

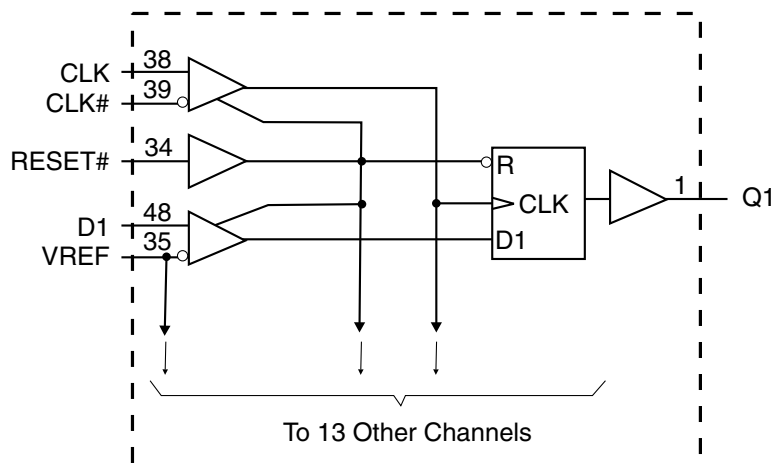
Pin Configuration



48-Pin TSSOP & TVSOP

6.10 mm. Body, 0.50 mm. pitch = TSSOP
4.40 mm. Body, 0.40 mm. pitch = TSSOP (TVSOP)

Block Diagram





General Description

The 14-bit ICSSSTV16857 is a universal bus driver designed for 2.3V to 2.7V VDD operation and SSTL_2 I/O Levels except for the RESET# input which is LVCMOS.

Data flow from D to Q is controlled by the differential clock, CLK, CLK# and RESET#. Data is triggered on the positive edge of CLK. CLK# must be used to maintain noise margins. RESET# must be supported with LVCMOS levels as VREF may not be stable during power-up. RESET# is asynchronous and is intended for power-up only and when low assures that all of the registers reset to the Low State, Q outputs are low, and all input receivers, data and clock are switched off.

Pin Configuration

| PIN NUMBER | PIN NAME | TYPE | DESCRIPTION |
|--|----------|--------|-------------------------|
| 24, 23, 20, 19, 18, 15, 14, 11, 10, 7, 6, 5, 2, 1 | Q (14:1) | OUTPUT | Data output |
| 3, 8, 13, 22, 27, 36, 46 | GND | PWR | Ground |
| 4, 9, 12, 16, 21 | VDDQ | PWR | Output supply voltage |
| 25, 26, 29, 30, 31, 32, 33, 40, 41, 42, 43, 44, 47, 48 | D (14:1) | INPUT | Data input |
| 38 | CLK | INPUT | Positive clock input |
| 39 | CLK# | INPUT | Negative clock input |
| 28, 37, 45 | VDD | PWR | Core supply voltage |
| 34 | RESET# | INPUT | Reset (active low) |
| 35 | VREF | INPUT | Input reference voltage |



Absolute Maximum Ratings

| | |
|--|-------------------|
| Storage Temperature | -65°C to +150°C |
| Supply Voltage | -0.5 to 3.6V |
| Input Voltage ¹ | -0.5 to VDD +0.5 |
| Output Voltage ^{1,2} | -0.5 to VDDQ +0.5 |
| Input Clamp Current | ±50 mA |
| Output Clamp Current | ±50mA |
| Continuous Output Current | ±50mA |
| VDD, VDDQ or GND Current/Pin | ±100mA |
| Package Thermal Impedance ³ | 55°C/W |

Notes:

1. The input and output negative voltage ratings may be excluded if the input and output clamp ratings are observed.
2. This current will flow only when the output is in the high state level $V_0 > V_{DDQ}$.
3. The package thermal impedance is calculated in accordance with JESD 51.

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.

Recommended Operating Conditions

| PARAMETER | DESCRIPTION | | MIN | TYP | MAX | UNITS |
|------------------|--|-------------|----------------------------|------------------|----------------------------|-------|
| V _{DD} | Supply Voltage | | 2.3 | 2.5 | 2.7 | V |
| V _{DDQ} | I/O Supply Voltage | | 2.3 | 2.5 | 2.7 | |
| V _{REF} | Reference Voltage $V_{REF} = 0.5 \times V_{DDQ}$ | | 1.15 | 1.25 | 1.35 | |
| V _{TT} | Termination Voltage | | V _{REF} -0.04 | V _{REF} | V _{REF} -0.04 | |
| V _I | Input Voltage | | 0 | | V _{DD} | |
| V _{IH} | DC Input High Voltage | Data Inputs | V _{REF} +0.15 | | | |
| V _{IH} | AC Input High Voltage | | V _{REF} +0.31 | | | |
| V _{IL} | DC Input Low Voltage | | | | V _{REF} -0.15 | |
| V _{IL} | AC Input Low Voltage | | | | V _{REF} -0.31 | |
| V _{IH} | Input High Voltage Level | RESET# | 1.7 | | | |
| V _{IL} | Input Low Voltage Level | | | | 0.7 | |
| V _{ICR} | Common mode Input Range | CLK, CLK# | 0.97 | | 1.53 | |
| V _{ID} | Differential Input Voltage | | 0.36 | | | |
| V _{IX} | Cross Point Voltage of Differential Clock Pair | | (V _{DDQ} /2) -0.2 | | (V _{DDQ} /2) +0.2 | |
| I _{OH} | High-Level Output Current | | | | -20 | mA |
| I _{OL} | Low-Level Output Current | | | | 20 | |
| T _A | Operating Free-Air Temperature | | 0 | | 70 | °C |

¹Guaranteed by design, not 100% tested in production.



Electrical Characteristics - DC

$T_A = 0 - 70^\circ \text{C}$; $V_{DD} = 2.5 \text{ V} \pm 200\text{mV}$, $V_{DDQ} = 2.5\text{V} \pm 200\text{mV}$; (unless otherwise stated)

| SYMBOL | PARAMETERS | CONDITIONS | VDD | MIN | TYP | MAX | UNITS |
|-----------------|---------------------------------------|--|----------|----------------|------|---------|-------------------------------------|
| V_{IK} | | $I_I = -18\text{mA}$ | 2.3V | | | -1.2 | |
| | | $I_{OH} = -100\mu\text{A}$ | 2.3V-2.7 | $V_{DD} - 0.2$ | 2.5 | | |
| V_{OH} | | $I_{OH} = -16\text{mA}$ | 2.3V | 1.95 | 2 | | |
| | | $I_{OL} = 100\mu\text{A}$ | 2.3-2.7V | | 0 | 0.2 | V |
| V_{OL} | | $I_{OL} = 16\text{mA}$ | 2.3V | | 0.16 | 0.35 | |
| I_I | All Inputs | $V_I = V_{DD}$ or GND | 2.7V | | | ± 5 | μA |
| I_{DD} | Standby (Static) | RESET# = GND | 2.7V | | | 0.01 | μA |
| | Operating (Static) | $V_I = V_{IH(AC)}$ or $V_{IL(AC)}$, RESET# = V_{DD} | | | | TBD | mA |
| I_{DDD} | Dynamic operating clock only | RESET = V_{DD} , $V_I = V_{IH(AC)}$ or $V_{IL(AC)}$, CK and CK# switching 50% duty cycle. | | | | TBD | $\mu\text{A}/\text{clock MHz}$ |
| | Dynamic Operating per each data input | RESET# = V_{DD} , $V_I = V_{IH(AC)}$ or $V_{IL(AC)}$, CK and CK# switching 50% duty cycle. One data input switching at half clock frequency, 50% duty cycle | | | | TBD | $\mu\text{A}/\text{clock MHz/data}$ |
| r_{OH} | Output High | $I_{OH} = -20\text{mA}$ | 2.3-2.7V | 7 | 15 | 20 | Ω |
| r_{OL} | Output Low | $I_{OL} = 20\text{mA}$ | 2.3-2.7V | 7 | 10 | 20 | Ω |
| | $[r_{OH} - r_{OL}]$ each | | | | | | |
| $r_{O(\Delta)}$ | separate bit | $I_O = 20\text{mA}$, $T_A = 25^\circ \text{C}$ | 2.5V | | | 4 | Ω |
| | Data Inputs | $V_I = V_{REF} \pm 310\text{mV}$ | | 2.5 | | 3.5 | |
| C_i | CK and CK# | $V_{ICR} = 1.25\text{V}$, $V_{I(PP)} = 360\text{mV}$ | 2.5V | 2.5 | | 3.5 | pF |

Notes:

1 - Guaranteed by design, not 100% tested in production.



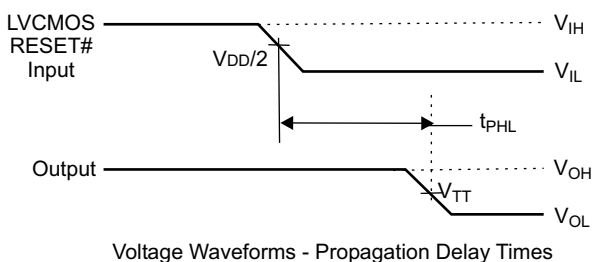
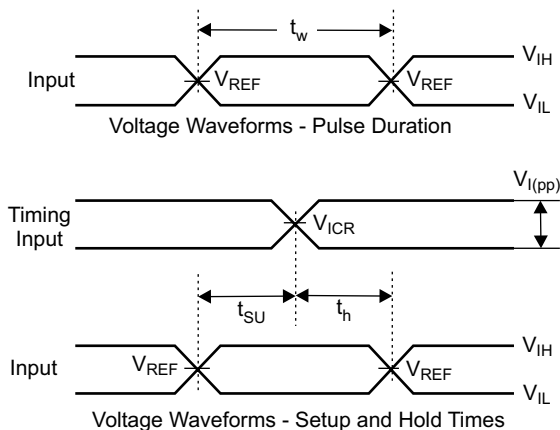
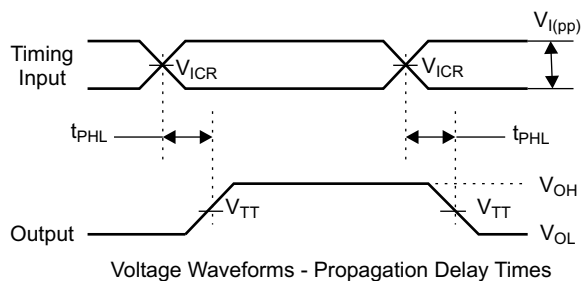
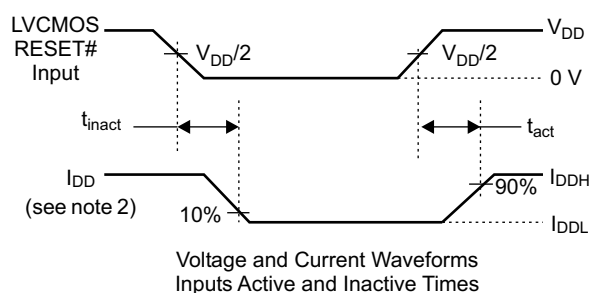
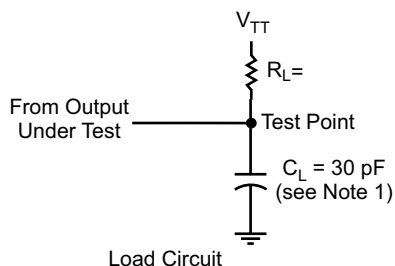
Timing Requirements

(over recommended operating free-air temperature range, unless otherwise noted)

| SYMBOL | PARAMETERS | | VDD=2.5±0.2V | | | UNITS |
|--------------------|--|------------------------|--------------|-------|-----|-------|
| | | | MIN | TYP | MAX | |
| f_{clock} | Clock frequency | | | 133 | 200 | MHz |
| t_{PD} | Clock to output time | | 1.1 | 2.4 | 2.8 | ns |
| t_{RST} | Reset to output time | | | 3.1 | 5 | ns |
| t_{SL} | Output slew rate | | 1 | 1.5 | 4 | V/ns |
| t_{SU} | Setup time, fast slew rate ^{2, 4} | Data before CK↑ , CK#↓ | 0.75 | 0.018 | | ns |
| | Setup time, slow slew rate ^{3, 4} | | 0.9 | | | ns |
| T_{h} | Hold time, fast slew rate ^{2, 4} | Data after CK↑ , CK#↓ | 0.75 | 0.145 | | ns |
| | Hold time, slow slew rate ^{3, 4} | | 0.9 | | | ns |

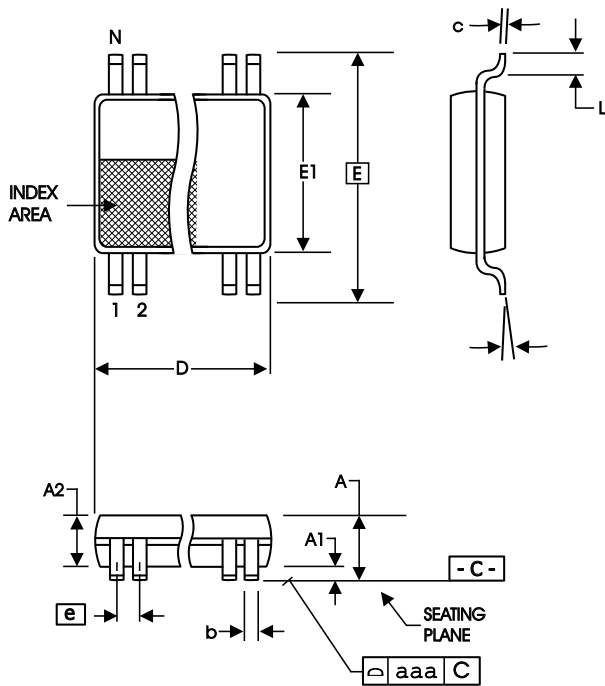
- Notes:
- 1 - Guaranteed by design, not 100% tested in production.
 - 2 - For data signal input slew rate =1V/ns.
 - 4 - CLK, CLK# signals input slew rates are =1V/ns.
 - 3 - For data signal input slew rate =0.5V/ns and < 1V/ns.

| Switching Characteristics | | | | | | |
|---|-----------|----------|--------------|-----|-----|-------|
| (over recommended operating free-air temperature range, unless otherwise noted) | | | | | | |
| SYMBOL | From | To | VDD=2.5±0.2V | | | UNITS |
| | (Input) | (Output) | MIN | TYP | MAX | |
| f_{clock} | | | | 133 | 200 | MHz |
| t_{PD} | CLK, CLK# | Q | 1.1 | 2.4 | 2.8 | ns |
| t_{ph1} | RESET# | Q | | 3.1 | 5 | ns |



Parameter Measurement Information ($V_{DD} = 2.5V \pm 0.2V$)

- Notes:
1. CL includes probe and jig capacitance.
 2. I_{DD} tested with clock and data inputs held at V_{DD} or GND, and $I_o = 0 \text{ mA}$.
 3. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_o = 50 \Omega$, input slew rate = $1 \text{ V/ns} \pm 20\%$ (unless otherwise specified).
 4. The outputs are measured one at a time with one transition per measurement.
 5. $V_{TT} = V_{REF} = V_{DDQ}/2$
 6. $V_{IH} = V_{REF} + 310 \text{ mV}$ (ac voltage levels) for differential inputs. $V_{IH} = V_{DD}$ for LVC MOS input.
 7. $V_{IL} = V_{REF} - 310 \text{ mV}$ (ac voltage levels) for differential inputs. $V_{IL} = \text{GND}$ for LVC MOS input.
 8. t_{PLH} and t_{PHL} are the same as t_{pd}



| SYMBOL | In Millimeters | | In Inches | |
|----------|-------------------|-------------------|-------------------|-------------------|
| | COMMON DIMENSIONS | COMMON DIMENSIONS | COMMON DIMENSIONS | COMMON DIMENSIONS |
| | MIN | MAX | MIN | MAX |
| A | -- | 1.20 | -- | .047 |
| A1 | 0.05 | 0.15 | .002 | .006 |
| A2 | 0.80 | 1.05 | .032 | .041 |
| b | 0.17 | 0.27 | .007 | .011 |
| c | 0.09 | 0.20 | .0035 | .008 |
| D | SEE VARIATIONS | | SEE VARIATIONS | |
| E | 8.10 BASIC | | 0.319 BASIC | |
| E1 | 6.00 | 6.20 | .236 | .244 |
| e | 0.50 BASIC | | 0.020 BASIC | |
| L | 0.45 | 0.75 | .018 | .030 |
| N | SEE VARIATIONS | | SEE VARIATIONS | |
| α | 0° | 8° | 0° | 8° |
| aaa | -- | 0.10 | -- | .004 |

VARIATIONS

| N | D mm. | | D (inch) | |
|----|-------|-------|----------|------|
| | MIN | MAX | MIN | MAX |
| 48 | 12.40 | 12.60 | .488 | .496 |

Reference Doc.: JEDEC Publication 95, MO-153

10-0039

6.10 mm. Body, 0.50 mm. pitch TSSOP
(240 mil) (0.020 mil)

Ordering Information

ICSSSTV16857yG-T

Example:

ICS XXXX y G - PPP - T

Designation for tape and reel packaging

Pattern Number (2 or 3 digit number for parts with ROM code patterns)

Package Type

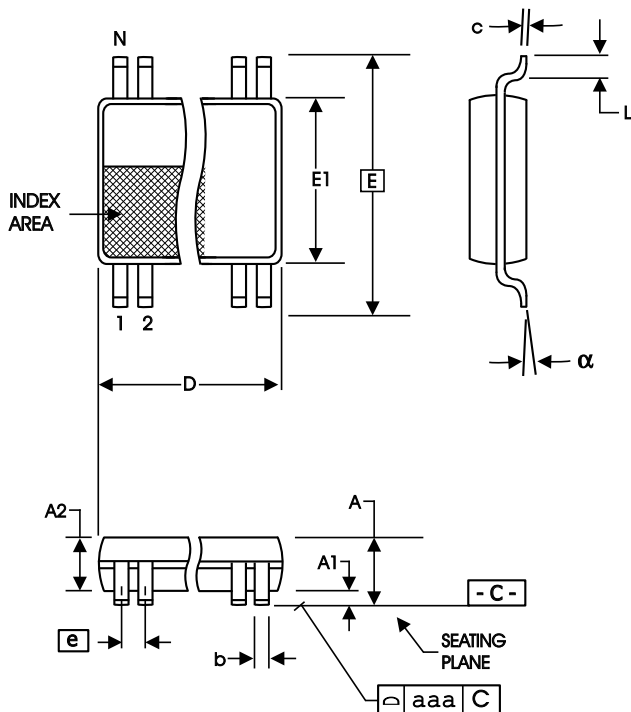
G=TSSOP

Revision Designator (will not correlate with datasheet revision)

Device Type (consists of 3 or 4 digit numbers)

Prefix

ICS, AV = Standard Device



| SYMBOL | In Millimeters | | In Inches | |
|--------|----------------|------|----------------|------|
| | MIN | MAX | MIN | MAX |
| A | -- | 1.20 | -- | .047 |
| A1 | 0.05 | 0.15 | .002 | .006 |
| A2 | 0.80 | 1.05 | .032 | .041 |
| b | 0.13 | 0.23 | .005 | .009 |
| c | 0.09 | 0.20 | .0035 | .008 |
| D | SEE VARIATIONS | | SEE VARIATIONS | |
| E | 6.40 BASIC | | 0.252 BASIC | |
| E1 | 4.30 | 4.50 | .169 | .177 |
| e | 0.40 BASIC | | 0.016 BASIC | |
| L | 0.45 | 0.75 | .018 | .030 |
| N | SEE VARIATIONS | | SEE VARIATIONS | |
| alpha | 0° | 8° | 0° | 8° |
| aaa | -- | 0.08 | -- | .003 |

VARIATIONS

| N | D mm. | | D (inch) | |
|----|-------|------|----------|------|
| | MIN | MAX | MIN | MAX |
| 48 | 9.60 | 9.80 | .378 | .386 |

Reference Doc.: JEDEC Publication 95, MO-153

10-0037

4.40 mm. Body, 0.40 mm. pitch TSSOP
(173 mil) (16 mil)

Ordering Information

ICSSSTV16857yL-T

Example:

ICS XXXX y L - PPP - T

Designation for tape and reel packaging

Pattern Number (2 or 3 digit number for parts with ROM code patterns)

Package Type

L=TSSOP (TVSOP)

Revision Designator (will not correlate with datasheet revision)

Device Type (consists of 3 or 4 digit numbers)

Prefix

ICS, AV = Standard Device