

## **±15kV ESD Protected, +3.3V, 1Microamp, 250kbps, RS-232 Transmitters/Receivers**

The Intersil 5962-062070xQxA devices are 3.3V powered RS-232 transmitters/receivers which meet EIA/TIA-232 and V.28/V.24 specifications, even at  $V_{CC} = 3.0V$ . Additionally, they provide ±15kV ESD protection (IEC61000-4-2 Air Gap and MIL-STD 883 Human Body Model) on transmitter outputs and receiver inputs (RS-232 pins). Targeted applications include ruggedized portable products and remotely deployed devices exposed to extreme temperature and humidity where the low operational and even lower standby, power consumption is critical. Efficient on-chip charge pumps, coupled with manual and automatic power-down functions (except for the 5962-0620703Q2A), reduce the standby supply current to a 1µA trickle. Small footprint packaging and the use of small, low value capacitors ensure board space savings as well. Data rates greater than 250kbps are guaranteed at worst case load conditions. This family is fully compatible with 3.3V-only systems.

**Specifications for QML devices are controlled by the Defense Logistics Agency Land and Maritime (DLA). The SMD numbers listed here must be used when ordering.**

**Detailed Electrical Specifications for these devices are contained in SMD 5962-06207. A “hot-link” is provided on our website for downloading.**

## **Ordering Information**

| DESC P/N        | CONFIGURATION  | TEMP (°C)   | PACKAGE    |
|-----------------|----------------|-------------|------------|
| 5962-0620701Q3A | ICL3243E 3D/5R | -55 to +125 | 28 Ld CLCC |
| 5962-0620702Q3A | ICL3238E 5D/3R | -55 to +125 | 28 Ld CLCC |
| 5962-0620703Q2A | ICL3232E 2D/2R | -55 to +125 | 20 Ld CLCC |
| 5962-0620704Q2A | ICL3221E 1D/1R | -55 to +125 | 20 Ld CLCC |

## **Features**

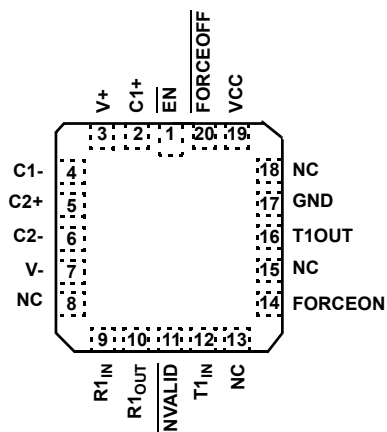
- Meets EIA/TIA-232 and V.28/V.24 Specifications at 3V
- Electrically Screened to DLA SMD#5962-06207
- QML Qualified per MIL-PRF-38535 Requirements
- SMD Compliance
- Military Temperature Range
- Latch-up Free
- Hermetic Package
- ESD Protection for RS-232 I/O Pins to ±15kV (IEC61000)
- Guaranteed Mouse Driveability (ICL3243E)
- Requires Single +3.3V ±10% Power Supply
- RS-232 Compatible with  $V_{CC} = 2.7V$
- Receiver Hysteresis for Improved Noise Immunity
- Low Power Automatic Power-down Modes (except for ICL3232E) ..... 1µA
- Guaranteed Minimum 250kbps Data Rate
- Manual and Automatic Power-down Features
- Multiple Drivers/Receivers
- On-Chip Voltage Converters Require Only Four External 0.1µF Capacitors
- Regulated Dual Charge Pumps

## **Applications**

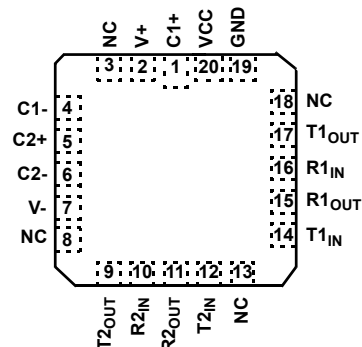
- Any Military or High-Rel System Requiring RS-232 Communication Ports
  - Battery Powered, Hand-Held, and Portable Equipment
  - Ruggedized Handheld GPS, Laptop Computers, Notebooks, Palmtops
  - Industrial Control/Shop Floor Communications
  - Field Deployed Sensors/Devices Exposed to Extreme Temperature/Humidity
  - Ruggedized Cellular/Mobile Phones

## Pinouts

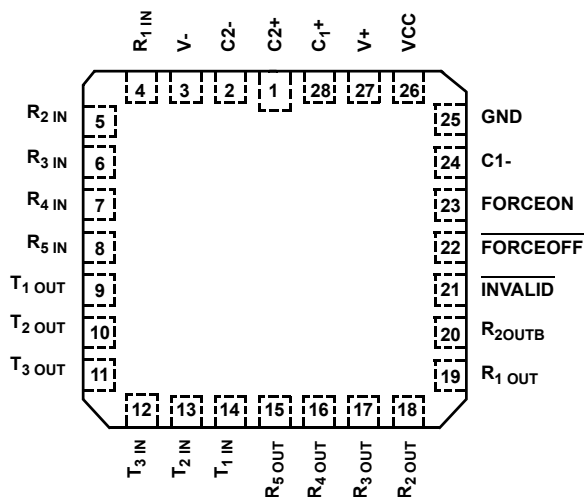
ICL3221E (CLCC)  
TOP VIEW



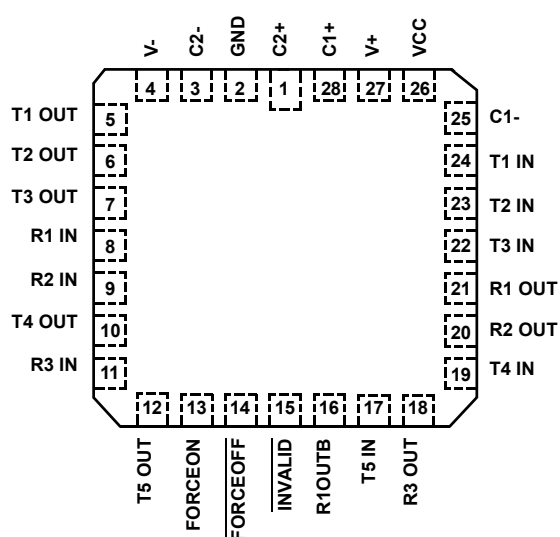
ICL3232E (CLCC)  
TOP VIEW



ICL3243E (CLCC)  
TOP VIEW



ICL3238E (CLCC)  
TOP VIEW



## Pin Descriptions

| PIN                          | FUNCTION                                                                                                                                               |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| V <sub>CC</sub>              | System power supply input (3.0V to 3.6V).                                                                                                              |
| V+                           | Internally generated positive transmitter supply (+5.5V).                                                                                              |
| V-                           | Internally generated negative transmitter supply (-5.5V).                                                                                              |
| GND                          | Ground connection.                                                                                                                                     |
| C1+                          | External capacitor (voltage doubler) is connected to this lead.                                                                                        |
| C1-                          | External capacitor (voltage doubler) is connected to this lead.                                                                                        |
| C2+                          | External capacitor (voltage inverter) is connected to this lead.                                                                                       |
| C2-                          | External capacitor (voltage inverter) is connected to this lead.                                                                                       |
| T <sub>IN</sub>              | TTL/CMOS compatible transmitter Inputs. (Note 1)                                                                                                       |
| T <sub>OUT</sub>             | ±15kV ESD Protected, RS-232 level (nominally ±5.5V) transmitter outputs.                                                                               |
| R <sub>IN</sub>              | ±15kV ESD Protected, RS-232 compatible receiver inputs.                                                                                                |
| R <sub>OUT</sub>             | TTL/CMOS level receiver outputs.                                                                                                                       |
| R <sub>OUTB</sub>            | TTL/CMOS level, noninverting, always enabled receiver outputs.                                                                                         |
| $\overline{\text{INVALID}}$  | Active low output that indicates if no valid RS-232 levels are present on any receiver input.                                                          |
| $\overline{\text{EN}}$       | Active low receiver enable control; doesn't disable R <sub>OUTB</sub> outputs.                                                                         |
| $\overline{\text{FORCEOFF}}$ | Active low control to shut down transmitters and on-chip power supply. This overrides any automatic circuitry and FORCEON (See Tables 1 & 2, Note 1).  |
| FORCEON                      | Active high input to override automatic powerdown circuitry thereby keeping transmitters active. ( $\overline{\text{FORCEOFF}}$ must be high, Note 1). |

### NOTE:

- The ICL3238E input pins incorporate positive feedback resistors. Once the input is driven to a valid logic level, the feedback resistor maintains that logic level until V<sub>CC</sub> is removed. Unused transmitter inputs may be left unconnected by the user.

**TABLE 1. POWER-DOWN LOGIC TRUTH TABLE**

| RCVR OR XMTR EDGE WITHIN 30 SEC? | $\overline{\text{FORCEOFF}}$ INPUT | FORCEON INPUT | TRANSMITTER OUTPUTS | RECEIVER OUTPUTS | R <sub>OUTB</sub> OUTPUT | RS-232 LEVEL PRESENT AT RECEIVER INPUT? | $\overline{\text{INVALID}}$ OUTPUT | MODE OF OPERATION                                    |
|----------------------------------|------------------------------------|---------------|---------------------|------------------|--------------------------|-----------------------------------------|------------------------------------|------------------------------------------------------|
| <b>ICL3238E</b>                  |                                    |               |                     |                  |                          |                                         |                                    |                                                      |
| No                               | H                                  | H             | Active              | Active           | Active                   | No                                      | L                                  | Normal Operation (Enhanced Auto Power-down Disabled) |
| No                               | H                                  | H             | Active              | Active           | Active                   | Yes                                     | H                                  |                                                      |
| Yes                              | H                                  | L             | Active              | Active           | Active                   | No                                      | L                                  | Normal Operation (Enhanced Auto Power-down Enabled)  |
| Yes                              | H                                  | L             | Active              | Active           | Active                   | Yes                                     | H                                  |                                                      |
| No                               | H                                  | L             | High-Z              | Active           | Active                   | No                                      | L                                  | Power-down Due to Enhanced Auto Power-down Logic     |
| No                               | H                                  | L             | High-Z              | Active           | Active                   | Yes                                     | H                                  |                                                      |
| X                                | L                                  | X             | High-Z              | High-Z           | Active                   | No                                      | L                                  | Manual Power-down                                    |
| X                                | L                                  | X             | High-Z              | High-Z           | Active                   | Yes                                     | H                                  |                                                      |

TABLE 1. POWER-DOWN LOGIC TRUTH TABLE (Continued)

| RCVR OR<br>XMTR<br>EDGE<br>WITHIN 30<br>SEC?                                | $\overline{\text{FORCEOFF}}$<br>INPUT | FORCEON<br>INPUT | TRANSMITTER<br>OUTPUTS | RECEIVER<br>OUTPUTS | R <sub>OUTB</sub><br>OUTPUT | RS-232<br>LEVEL<br>PRESENT<br>AT<br>RECEIVER<br>INPUT? | $\overline{\text{INVALID}}$<br>OUTPUT | MODE OF OPERATION      |
|-----------------------------------------------------------------------------|---------------------------------------|------------------|------------------------|---------------------|-----------------------------|--------------------------------------------------------|---------------------------------------|------------------------|
| <b>INVALID DRIVING FORCEON AND FORCEOFF (EMULATES AUTOMATIC POWER-DOWN)</b> |                                       |                  |                        |                     |                             |                                                        |                                       |                        |
| X                                                                           | Note 2                                | Note 2           | Active                 | Active              | Active                      | Yes                                                    | H                                     | Normal Operation       |
| X                                                                           | Note 2                                | Note 2           | High-Z                 | High-Z              | Active                      | No                                                     | L                                     | Forced Auto Power-down |

NOTE:

- Input is connected to  $\overline{\text{INVALID}}$  Output.

TABLE 2. POWER-DOWN AND ENABLE LOGIC TRUTH TABLE

| RS-232<br>SIGNAL<br>PRESENT<br>AT<br>RECEIVER<br>INPUT? | $\overline{\text{FORCEOFF}}$<br>INPUT | FORCEON<br>INPUT | $\overline{\text{EN}}$<br>INPUT | TRANSMITTER<br>OUTPUTS | RECEIVER<br>OUTPUTS | (NOTE 3)<br>R <sub>OUTB</sub><br>OUTPUTS | $\overline{\text{INVALID}}$<br>OUTPUT | MODE OF OPERATION                              |
|---------------------------------------------------------|---------------------------------------|------------------|---------------------------------|------------------------|---------------------|------------------------------------------|---------------------------------------|------------------------------------------------|
| <b>ICL3221E</b>                                         |                                       |                  |                                 |                        |                     |                                          |                                       |                                                |
| No                                                      | H                                     | H                | L                               | Active                 | Active              | N.A.                                     | L                                     | Normal Operation<br>(Auto Power-down Disabled) |
| No                                                      | H                                     | H                | H                               | Active                 | High-Z              | N.A.                                     | L                                     |                                                |
| Yes                                                     | H                                     | L                | L                               | Active                 | Active              | N.A.                                     | H                                     | Normal Operation<br>(Auto Power-down Enabled)  |
| Yes                                                     | H                                     | L                | H                               | Active                 | High-Z              | N.A.                                     | H                                     |                                                |
| No                                                      | H                                     | L                | L                               | High-Z                 | Active              | N.A.                                     | L                                     | Power-down Due to Auto Power-down<br>Logic     |
| No                                                      | H                                     | L                | H                               | High-Z                 | High-Z              | N.A.                                     | L                                     |                                                |
| Yes                                                     | L                                     | X                | L                               | High-Z                 | Active              | N.A.                                     | H                                     | Manual Power-down                              |
| Yes                                                     | L                                     | X                | H                               | High-Z                 | High-Z              | N.A.                                     | H                                     | Manual Power-down w/Rcvr. Disabled             |
| No                                                      | L                                     | X                | L                               | High-Z                 | Active              | N.A.                                     | L                                     | Manual Power-down                              |
| No                                                      | L                                     | X                | H                               | High-Z                 | High-Z              | N.A.                                     | L                                     | Manual Power-down w/Rcvr. Disabled             |
| <b>ICL3243E</b>                                         |                                       |                  |                                 |                        |                     |                                          |                                       |                                                |
| No                                                      | H                                     | H                | N.A.                            | Active                 | Active              | Active                                   | L                                     | Normal Operation<br>(Auto Power-down Disabled) |
| Yes                                                     | H                                     | L                | N.A.                            | Active                 | Active              | Active                                   | H                                     | Normal Operation<br>(Auto Power-down Enabled)  |
| No                                                      | H                                     | L                | N.A.                            | High-Z                 | Active              | Active                                   | L                                     | Power-down Due to Auto Power-down<br>Logic     |
| Yes                                                     | L                                     | X                | N.A.                            | High-Z                 | High-Z              | Active                                   | H                                     | Manual Power-down                              |
| No                                                      | L                                     | X                | N.A.                            | High-Z                 | High-Z              | Active                                   | L                                     | Manual Power-down                              |

NOTE:

- Applies only to the ICL3243E.

## Absolute Maximum Ratings

|                                                                |                          |
|----------------------------------------------------------------|--------------------------|
| $V_{CC}$ to Ground                                             | -0.3V to 6V              |
| V+ to Ground                                                   | -0.3V to 7V              |
| V- to Ground                                                   | +0.3V to -7V             |
| V+ to V-                                                       | 14V                      |
| <b>Input Voltages</b>                                          |                          |
| $T_{IN}$ , FORCEOFF, FORCEON, $\overline{EN}$                  | -0.3V to 6V              |
| $R_{IN}$                                                       | $\pm 25V$                |
| <b>Output Voltages</b>                                         |                          |
| $T_{OUT}$                                                      | $\pm 13.2V$              |
| $R_{OUT}$ , INVALID                                            | -0.3V to $V_{CC} + 0.3V$ |
| <b>Short Circuit Duration</b>                                  |                          |
| $T_{OUT}$                                                      | Continuous               |
| <b>ESD Rating (Receiver Input and Transmitter Output Pins)</b> |                          |
|                                                                | $\pm 15kV$               |

## Thermal Information

|                                                |                      |
|------------------------------------------------|----------------------|
| Thermal Resistance (Typical)                   | $\theta_{JA}$ (°C/W) |
| 20 Ld CLCC Package                             | 90                   |
| 28 Ld CLCC Package                             | 70                   |
| Maximum Junction Temperature (Ceramic Package) |                      |
| Maximum Storage Temperature Range              |                      |
| Maximum Lead Temperature (Soldering 10s)       |                      |
|                                                | 150°C                |
|                                                | -65°C to 150°C       |
|                                                | 300°C                |

## Operating Conditions

|                   |                |
|-------------------|----------------|
| Temperature Range |                |
| ICL32XXE          | -55°C to 125°C |

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

## Electrical Specifications ICL3221E, ICL3232E, ICL3243E Test Conditions: $V_{CC} = 3V$ to 3.6V, C1 - C4 = 0.1mF; Unless Otherwise Specified. Typical values are at $T_A = 25^\circ C$ , $V_{CC} = 3.3V$

| PARAMETER                                                                                  | TEST CONDITIONS                                                                                                    |                                               | TEMP<br>(°C) | MIN                  | TYP                  | MAX | UNITS |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------|----------------------|----------------------|-----|-------|
| DC CHARACTERISTICS                                                                         |                                                                                                                    |                                               |              |                      |                      |     |       |
| Supply Current, Automatic Power-down                                                       | All R <sub>IN</sub> Open, FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{\text{CC}}$<br>(ICL3221E, ICL3243E Only) |                                               | Full         | -                    | 1                    | 10  | μA    |
| Supply Current, Power-down                                                                 | $\overline{\text{FORCEOFF}} = \text{GND}$ (Except ICL3232E)                                                        |                                               | Full         | -                    | 1                    | 10  | μA    |
| Supply Current, Power-up                                                                   | All Outputs Unloaded,<br>FORCEON = FORCEOFF = V <sub>CC</sub>                                                      | V <sub>CC</sub> = 3.15V,<br>ICL3221E/ICL3232E | Full         | -                    | 0.3                  | 1.8 | mA    |
|                                                                                            |                                                                                                                    | V <sub>CC</sub> = 3.0V, ICL3243E              | Full         | -                    | 0.3                  | 1.8 | mA    |
| LOGIC AND TRANSMITTER INPUTS AND RECEIVER OUTPUTS                                          |                                                                                                                    |                                               |              |                      |                      |     |       |
| Input Logic Threshold Low                                                                  | T <sub>IN</sub> , FORCEON, $\overline{\text{FORCEOFF}}$ , $\overline{\text{EN}}$                                   |                                               | Full         | -                    | -                    | 0.8 | V     |
| Input Logic Threshold High                                                                 | T <sub>IN</sub> , FORCEON, $\overline{\text{FORCEOFF}}$ , $\overline{\text{EN}}$                                   |                                               | Full         | 2.0                  | -                    | -   | V     |
| Input Leakage Current                                                                      | T <sub>IN</sub> , FORCEON, $\overline{\text{FORCEOFF}}$ , $\overline{\text{EN}}$                                   |                                               | Full         | -                    | ±0.01                | ±10 | μA    |
| Output Leakage Current<br>(Except ICL3232E)                                                | $\overline{\text{FORCEOFF}} = \text{GND}$ or $\overline{\text{EN}} = V_{\text{CC}}$                                |                                               | Full         | -                    | ±0.05                | ±10 | μA    |
| Output Voltage Low                                                                         | I <sub>OUT</sub> = 1.6mA                                                                                           |                                               | Full         | -                    | -                    | 0.4 | V     |
| Output Voltage High                                                                        | I <sub>OUT</sub> = -1.0mA                                                                                          |                                               | Full         | V <sub>CC</sub> -0.6 | V <sub>CC</sub> -0.1 | -   | V     |
| AUTOMATIC POWER-DOWN (ICL3221E, ICL3243E Only, FORCEON = GND, FORCEOFF = V <sub>CC</sub> ) |                                                                                                                    |                                               |              |                      |                      |     |       |
| Receiver Input Thresholds to<br>Enable Transmitters                                        | Powers Up                                                                                                          |                                               | Full         | -2.7                 | -                    | 2.7 | V     |
| Receiver Input Thresholds to<br>Disable Transmitters                                       | Powers Down                                                                                                        |                                               | Full         | -0.3                 | -                    | 0.3 | V     |
| $\overline{\text{INVALID}}$ Output Voltage Low                                             | I <sub>OUT</sub> = 1.6mA                                                                                           |                                               | Full         | -                    | -                    | 0.4 | V     |
| $\overline{\text{INVALID}}$ Output Voltage High                                            | I <sub>OUT</sub> = -1.0mA                                                                                          |                                               | Full         | V <sub>CC</sub> -0.6 | -                    | -   | V     |
| RECEIVER INPUTS                                                                            |                                                                                                                    |                                               |              |                      |                      |     |       |
| Input Voltage Range                                                                        |                                                                                                                    |                                               | Full         | -25                  | -                    | 25  | V     |
| Input Threshold Low                                                                        |                                                                                                                    |                                               | Full         | 0.6                  | 1.2                  | -   | V     |
| Input Threshold High                                                                       |                                                                                                                    |                                               | Full         | -                    | 1.5                  | 2.4 | V     |
| Input Resistance                                                                           |                                                                                                                    |                                               | Full         | 3                    | 5                    | 7   | kΩ    |
| TRANSMITTER OUTPUTS                                                                        |                                                                                                                    |                                               |              |                      |                      |     |       |
| Output Voltage Swing                                                                       | All Transmitter Outputs Loaded with 3kW to Ground                                                                  |                                               | Full         | ±5.0                 | ±5.4                 | -   | V     |
| Output Resistance                                                                          | V <sub>CC</sub> = V+ = V- = 0V, Transmitter Output = ±2V                                                           |                                               | Full         | 300                  | 10M                  | -   | Ω     |

**Electrical Specifications** ICL3221E, ICL3232E, ICL3243E Test Conditions:  $V_{CC} = 3V$  to  $3.6V$ ,  $C_1 - C_4 = 0.1\mu F$ ; Unless Otherwise Specified. Typicals are at  $T_A = 25^\circ C$ ,  $V_{CC} = 3.3V$  (Continued)

| PARAMETER                                         | TEST CONDITIONS                                                                                                                                                                          | TEMP<br>(°C)                     | MIN  | TYP | MAX | UNITS |      |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------|-----|-----|-------|------|
| Output Short-Circuit Current                      |                                                                                                                                                                                          | Full                             | -    | ±35 | ±60 | mA    |      |
| Output Leakage Current                            | V <sub>OUT</sub> = ±12V, V <sub>CC</sub> = 0V or 3V to 3.6V<br>(ICL3232E, V <sub>CC</sub> = 0 only)<br>Automatic Power-down or $\overline{\text{FORCEOFF}}$ = GND                        | Full                             | -    | -   | ±25 | µA    |      |
| MOUSE DRIVEABILITY (ICL3243 Only)                 |                                                                                                                                                                                          |                                  |      |     |     |       |      |
| Transmitter Output Voltage                        | T1 <sub>IN</sub> = T2 <sub>IN</sub> = GND, T3 <sub>IN</sub> = V <sub>CC</sub> , T3 <sub>OUT</sub> Loaded with 3kW to GND, T1 <sub>OUT</sub> and T2 <sub>OUT</sub> Loaded with 2.5mA Each | Full                             | ±5   | -   | -   | V     |      |
| TIMING CHARACTERISTICS                            |                                                                                                                                                                                          |                                  |      |     |     |       |      |
| Maximum Data Rate                                 | R <sub>L</sub> = 3kW, C <sub>L</sub> = 1000pF, One Transmitter Switching                                                                                                                 |                                  | Full | 250 | 500 | -     | kbps |
| Transmitter Skew                                  | t <sub>PHL</sub> - t <sub>PLH</sub>                                                                                                                                                      |                                  | Full | -   | 200 | 1000  | ns   |
| Receiver Skew                                     | t <sub>PHL</sub> - t <sub>PLH</sub>                                                                                                                                                      |                                  | Full | -   | 100 | 1000  | ns   |
| Transition Region Slew Rate                       | V <sub>CC</sub> = 3.3V,<br>R <sub>L</sub> = 3kW to 7kW,<br>Measured From 3V to -3V or -3V to 3V                                                                                          | C <sub>L</sub> = 200pF to 2500pF | Full | 4   | 8.0 | 30    | V/µs |
|                                                   |                                                                                                                                                                                          | C <sub>L</sub> = 200pF to 1000pF | Full | 6   | -   | 30    | V/µs |
| ESD PERFORMANCE                                   |                                                                                                                                                                                          |                                  |      |     |     |       |      |
| RS-232 Pins (T <sub>OUT</sub> , R <sub>IN</sub> ) | Human Body Model (MIL-STD 883 Method 3015)                                                                                                                                               | 25                               | -    | ±15 | -   | kV    |      |
|                                                   | IEC61000-4-2 Contact Discharge                                                                                                                                                           | 25                               | -    | ±8  | -   | kV    |      |
|                                                   | IEC61000-4-2 Air Gap Discharge                                                                                                                                                           | 25                               | -    | ±15 | -   | kV    |      |
| All Other Pins                                    | Human Body Model (MIL-STD 883 Method 3015)                                                                                                                                               | 25                               | -    | ±2  | -   | kV    |      |

**Electrical Specifications** ICL3238E Test Conditions:  $V_{CC} = 3V$  to  $3.6V$ ,  $C_1 - C_4 = 0.1\mu F$ ; Unless Otherwise Specified. Typicals are at  $T_A = 25^\circ C$ ,  $V_{CC} = 3.3V$ 

| PARAMETER                                                | TEST CONDITIONS                                                                              | TEMP (°C) | MIN            | TYP            | MAX      | UNITS      |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------|-----------|----------------|----------------|----------|------------|
| <b>DC CHARACTERISTICS</b>                                |                                                                                              |           |                |                |          |            |
| Supply Current, Automatic Power-down                     | All $R_{IN}$ Open, $\overline{FORCEON} = GND$ , $\overline{FORCEOFF} = V_{CC}$               | Full      | -              | 1              | 10       | $\mu A$    |
| Supply Current, Power-down                               | $\overline{FORCEOFF} = GND$                                                                  | Full      | -              | 1              | 10       | $\mu A$    |
| Supply Current, Power-up                                 | All Outputs Unloaded, $\overline{FORCEON} = \overline{FORCEOFF} = V_{CC}$                    | Full      | -              | 0.3            | 1.8      | mA         |
| <b>LOGIC AND TRANSMITTER INPUTS AND RECEIVER OUTPUTS</b> |                                                                                              |           |                |                |          |            |
| Input Logic Threshold Low                                | $T_{IN}$ , $\overline{FORCEON}$ , $\overline{FORCEOFF}$ Wake up Threshold                    | Full      | -              | -              | 0.8      | V          |
| Input Logic Threshold High                               | $T_{IN}$ , $\overline{FORCEON}$ , $\overline{FORCEOFF}$ Wake up Threshold                    | Full      | 2.0            | -              | -        | V          |
| Input Leakage Current                                    | $T_{IN}$ , $\overline{FORCEON}$ , $\overline{FORCEOFF}$ , $V_{IN} = 0V$ or $V_{CC}$ (Note 4) | Full      | -              | $\pm 0.01$     | $\pm 10$ | $\mu A$    |
| Output Leakage Current                                   | $\overline{FORCEOFF} = GND$                                                                  | Full      | -              | $\pm 0.05$     | $\pm 10$ | $\mu A$    |
| Output Voltage Low                                       | $I_{OUT} = 1.0mA$                                                                            | Full      | -              | -              | 0.4      | V          |
| Output Voltage High                                      | $I_{OUT} = -1.0mA$                                                                           | Full      | $V_{CC} - 0.6$ | $V_{CC} - 0.1$ | -        | V          |
| <b>RECEIVER INPUTS</b>                                   |                                                                                              |           |                |                |          |            |
| Input Voltage Range                                      |                                                                                              | Full      | -25            | -              | 25       | V          |
| Input Threshold Low                                      |                                                                                              | Full      | 0.8            | 1.5            | -        | V          |
| Input Threshold High                                     |                                                                                              | Full      | -              | 1.8            | 2.4      | V          |
| Input Resistance                                         |                                                                                              | Full      | 3              | 5              | 7        | k $\Omega$ |

**Electrical Specifications** ICL3238E Test Conditions:  $V_{CC} = 3V$  to  $3.6V$ ,  $C_1 - C_4 = 0.1\mu F$ , Unless Otherwise Specified. Typicals are at  $T_A = 25^\circ C$ ,  $V_{CC} = 3.3V$  (Continued)

| PARAMETER                                                                  | TEST CONDITIONS                                                                                     | TEMP (°C)                        | MIN                  | TYP  | MAX  | UNITS |      |
|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------|----------------------|------|------|-------|------|
| ENHANCED AUTOMATIC POWER-DOWN (FORCEON = GND, FORCEOFF = V <sub>CC</sub> ) |                                                                                                     |                                  |                      |      |      |       |      |
| Receiver Input Thresholds to INVALID High                                  | Powered Up                                                                                          | Full                             | -2.7                 | -    | 2.7  | V     |      |
| Receiver Input Thresholds to INVALID Low                                   | Powered Down                                                                                        | Full                             | -0.3                 | -    | 0.3  | V     |      |
| INVALID Output Voltage Low                                                 | I <sub>OUT</sub> = 1.0mA                                                                            | Full                             | -                    | -    | 0.4  | V     |      |
| INVALID Output Voltage High                                                | I <sub>OUT</sub> = -1.0mA                                                                           | Full                             | V <sub>CC</sub> -0.6 | -    | -    | V     |      |
| TRANSMITTER OUTPUTS                                                        |                                                                                                     |                                  |                      |      |      |       |      |
| Output Voltage Swing                                                       | All Transmitter Outputs Loaded with 3kΩ to Ground                                                   | Full                             | ±5.0                 | ±5.4 | -    | V     |      |
| Output Short-Circuit Current                                               |                                                                                                     | Full                             | -                    | ±35  | ±60  | mA    |      |
| Output Leakage Current                                                     | V <sub>OUT</sub> = ±12V, V <sub>CC</sub> = 0V or 3V to 3.6V, Automatic Power-down or FORCEOFF = GND | Full                             | -                    | -    | ±25  | μA    |      |
| TIMING CHARACTERISTICS                                                     |                                                                                                     |                                  |                      |      |      |       |      |
| Maximum Data Rate                                                          | R <sub>L</sub> = 3kΩ, C <sub>L</sub> = 1000pF, One Transmitter Switching                            | Full                             | 250                  | 500  | -    | kbps  |      |
| Transmitter Skew                                                           | t <sub>PHL</sub> - t <sub>PLH</sub>                                                                 | Full                             | -                    | 200  | 1000 | ns    |      |
| Receiver Skew                                                              | t <sub>PHL</sub> - t <sub>PLH</sub>                                                                 | Full                             | -                    | 100  | 1000 | ns    |      |
| Transition Region Slew Rate                                                | V <sub>CC</sub> = 3.3V, R <sub>L</sub> = 3kΩ to 7kΩ, Measured From 3V to -3V or -3V to 3V           | C <sub>L</sub> = 150pF to 1000pF | Full                 | 6    | 15   | 30    | V/μs |
|                                                                            |                                                                                                     | C <sub>L</sub> = 150pF to 2500pF | Full                 | 4    | 12   | 30    | V/μs |
| ESD PERFORMANCE                                                            |                                                                                                     |                                  |                      |      |      |       |      |
| RS-232 Pins (T <sub>OUT</sub> , R <sub>IN</sub> )                          | IEC61000-4-2 Air Gap Discharge                                                                      | 25                               | -                    | ±15  | -    | kV    |      |
|                                                                            | IEC61000-4-2 Contact Discharge                                                                      | 25                               | -                    | ±8   | -    | kV    |      |
|                                                                            | Human Body Model (MIL-STD 883 Method 3015)                                                          | 25                               | -                    | ±15  | -    | kV    |      |
| All Other Pins                                                             | Human Body Model (MIL-STD 883 Method 3015)                                                          | 25                               | -                    | ±2.5 | -    | kV    |      |

NOTE:

- These inputs utilize a positive feedback resistor. The input current is negligible when the input is at either supply rail.

## Die Characteristics

### INTERFACE MATERIALS:

#### Glassivation:

Type: PSG (Phosphorous Silicon Glass)  
Thickness:  $13.0k\text{\AA} \pm 1.0k\text{\AA}$

#### Top Metallization:

Type: AlSiCu  
Thickness:  $10.0k\text{\AA} \pm 1k\text{\AA}$

### ASSEMBLY RELATED INFORMATION:

#### Substrate Potential:

GND

### ADDITIONAL INFORMATION:

#### Worst Case Current Density:

$< 2.0 \times 10^5 A/cm^2$

#### Transistor Count:

ICL3221E: 286  
ICL3232E: 296  
ICL3243E: 464  
ICL3238E: 1235

#### Process:

Si Gate CMOS

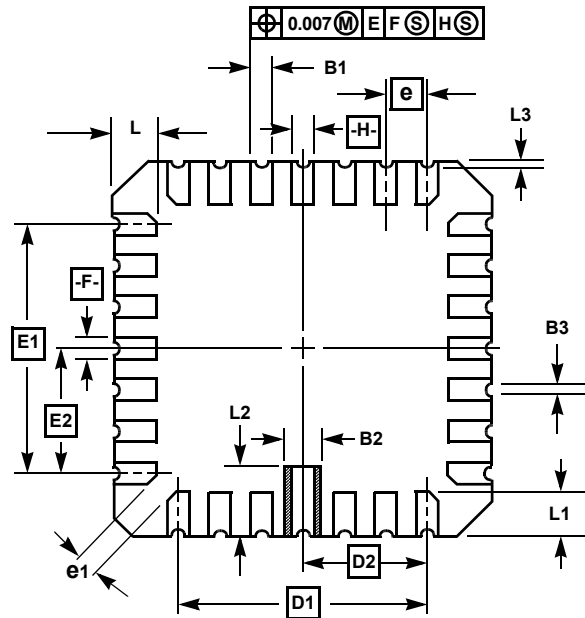
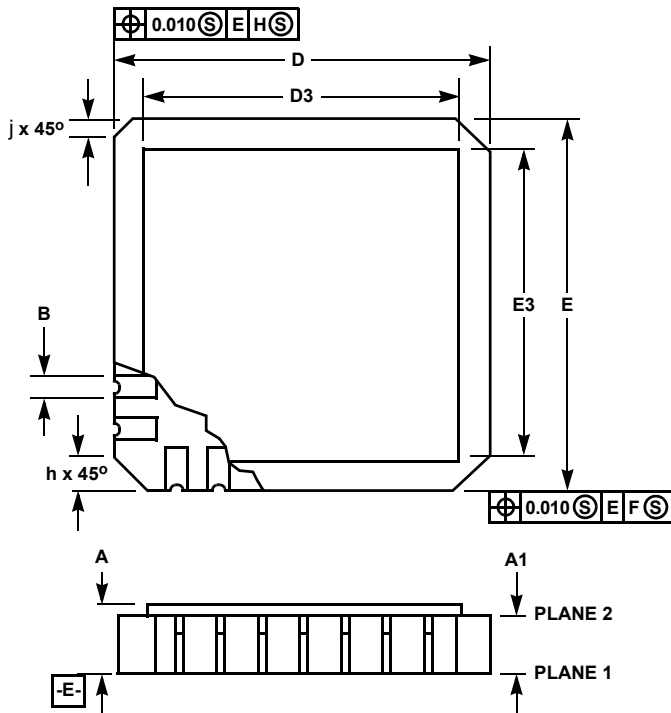
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## Ceramic Leadless Chip Carrier Packages (CLCC)



**J28.A MIL-STD-1835 CQCC1-N28 (C-4)**  
28 PAD CERAMIC LEADLESS CHIP CARRIER PACKAGE

| SYMBOL | INCHES    |       | MILLIMETERS |       | NOTES |
|--------|-----------|-------|-------------|-------|-------|
|        | MIN       | MAX   | MIN         | MAX   |       |
| A      | 0.060     | 0.100 | 1.52        | 2.54  | 6, 7  |
| A1     | 0.050     | 0.088 | 1.27        | 2.23  | -     |
| B      | -         | -     | -           | -     | -     |
| B1     | 0.022     | 0.028 | 0.56        | 0.71  | 2, 4  |
| B2     | 0.072 REF |       | 1.83 REF    |       | -     |
| B3     | 0.006     | 0.022 | 0.15        | 0.56  | -     |
| D      | 0.442     | 0.460 | 11.23       | 11.68 | -     |
| D1     | 0.300 BSC |       | 7.62 BSC    |       | -     |
| D2     | 0.150 BSC |       | 3.81 BSC    |       | -     |
| D3     | -         | 0.460 | -           | 11.68 | 2     |
| E      | 0.442     | 0.460 | 11.23       | 11.68 | -     |
| E1     | 0.300 BSC |       | 7.62 BSC    |       | -     |
| E2     | 0.150 BSC |       | 3.81 BSC    |       | -     |
| E3     | -         | 0.460 | -           | 11.68 | 2     |
| e      | 0.050 BSC |       | 1.27 BSC    |       | -     |
| e1     | 0.015     | -     | 0.38        | -     | 2     |
| h      | 0.040 REF |       | 1.02 REF    |       | 5     |
| j      | 0.020 REF |       | 0.51 REF    |       | 5     |
| L      | 0.045     | 0.055 | 1.14        | 1.40  | -     |
| L1     | 0.045     | 0.055 | 1.14        | 1.40  | -     |
| L2     | 0.075     | 0.095 | 1.90        | 2.41  | -     |
| L3     | 0.003     | 0.015 | 0.08        | 0.038 | -     |
| ND     | 7         |       | 7           |       | 3     |
| NE     | 7         |       | 7           |       | 3     |
| N      | 28        |       | 28          |       | 3     |

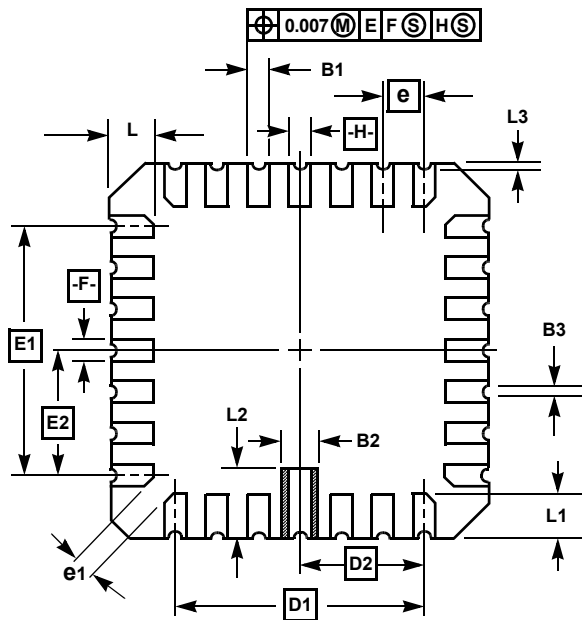
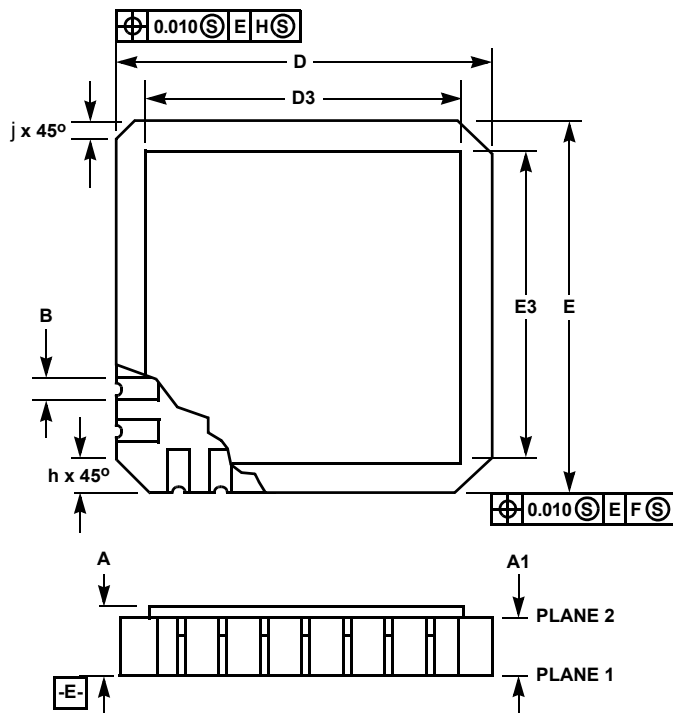
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### NOTES:

1. Metallized castellations shall be connected to plane 1 terminals and extend toward plane 2 across at least two layers of ceramic or completely across all of the ceramic layers to make electrical connection with the optional plane 2 terminals.
2. Unless otherwise specified, a minimum clearance of 0.015 inch (0.38mm) shall be maintained between all metallized features (e.g., lid, castellations, terminals, thermal pads, etc.)
3. Symbol "N" is the maximum number of terminals. Symbols "ND" and "NE" are the number of terminals along the sides of length "D" and "E", respectively.
4. The required plane 1 terminals and optional plane 2 terminals (if used) shall be electrically connected.
5. The corner shape (square, notch, radius, etc.) may vary at the manufacturer's option, from that shown on the drawing.
6. Chip carriers shall be constructed of a minimum of two ceramic layers.
7. Dimension "A" controls the overall package thickness. The maximum "A" dimension is package height before being solder dipped.
8. Dimensioning and tolerancing per ANSI Y14.5M-1982.
9. Controlling dimension: INCH.



## Ceramic Leadless Chip Carrier Packages (CLCC)



**J20.A MIL-STD-1835 CQCC1-N20 (C-2)**  
**20 PAD CERAMIC LEADLESS CHIP CARRIER PACKAGE**

| SYMBOL | INCHES    |       | MILLIMETERS |      | NOTES |
|--------|-----------|-------|-------------|------|-------|
|        | MIN       | MAX   | MIN         | MAX  |       |
| A      | 0.060     | 0.100 | 1.52        | 2.54 | 6, 7  |
| A1     | 0.050     | 0.088 | 1.27        | 2.23 | -     |
| B      | -         | -     | -           | -    | -     |
| B1     | 0.022     | 0.028 | 0.56        | 0.71 | 2, 4  |
| B2     | 0.072 REF |       | 1.83 REF    |      | -     |
| B3     | 0.006     | 0.022 | 0.15        | 0.56 | -     |
| D      | 0.342     | 0.358 | 8.69        | 9.09 | -     |
| D1     | 0.200 BSC |       | 5.08 BSC    |      | -     |
| D2     | 0.100 BSC |       | 2.54 BSC    |      | -     |
| D3     | -         | 0.358 | -           | 9.09 | 2     |
| E      | 0.342     | 0.358 | 8.69        | 9.09 | -     |
| E1     | 0.200 BSC |       | 5.08 BSC    |      | -     |
| E2     | 0.100 BSC |       | 2.54 BSC    |      | -     |
| E3     | -         | 0.358 | -           | 9.09 | 2     |
| e      | 0.050 BSC |       | 1.27 BSC    |      | -     |
| e1     | 0.015     | -     | 0.38        | -    | 2     |
| h      | 0.040 REF |       | 1.02 REF    |      | 5     |
| j      | 0.020 REF |       | 0.51 REF    |      | 5     |
| L      | 0.045     | 0.055 | 1.14        | 1.40 | -     |
| L1     | 0.045     | 0.055 | 1.14        | 1.40 | -     |
| L2     | 0.075     | 0.095 | 1.91        | 2.41 | -     |
| L3     | 0.003     | 0.015 | 0.08        | 0.38 | -     |
| ND     | 5         |       | 5           |      | 3     |
| NE     | 5         |       | 5           |      | 3     |
| N      | 20        |       | 20          |      | 3     |

Rev. 0 5/18/94

## NOTES:

1. Metallized castellations shall be connected to plane 1 terminals and extend toward plane 2 across at least two layers of ceramic or completely across all of the ceramic layers to make electrical connection with the optional plane 2 terminals.
2. Unless otherwise specified, a minimum clearance of 0.015 inch (0.38mm) shall be maintained between all metallized features (e.g., lid, castellations, terminals, thermal pads, etc.)
3. Symbol "N" is the maximum number of terminals. Symbols "ND" and "NE" are the number of terminals along the sides of length "D" and "E", respectively.
4. The required plane 1 terminals and optional plane 2 terminals (if used) shall be electrically connected.
5. The corner shape (square, notch, radius, etc.) may vary at the manufacturer's option, from that shown on the drawing.
6. Chip carriers shall be constructed of a minimum of two ceramic layers.
7. Dimension "A" controls the overall package thickness. The maximum "A" dimension is package height before being solder dipped.
8. Dimensioning and tolerancing per ANSI Y14.5M-1982.
9. Controlling dimension: INCH.