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Precision Low-voltage Amplifier

Features

- ❑ Low Offset:
 - 10 μ V Max.
- ❑ Low Drift:
 - 0.05 μ V/ $^{\circ}$ C Max.
- ❑ Low Noise:
 - 17 nV/ $\sqrt{\text{Hz}}$
- ❑ Open-loop Voltage Gain:
 - 150 dB Typ.
- ❑ Rail-to-Rail Inputs
- ❑ Rail-to-Rail Output Swing
 - to within 10 mV of supply voltage
- ❑ 2.1 mA Supply Current
- ❑ Slew rate:
 - 0.25 V/ μ s

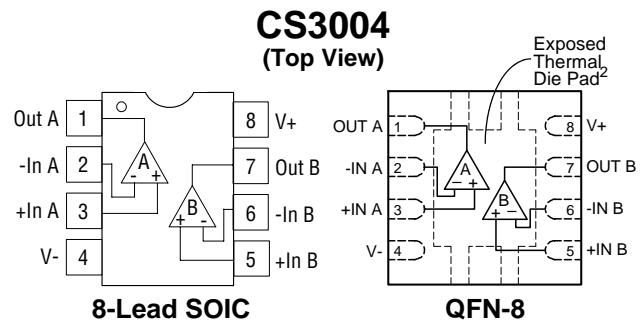
Applications

- ❑ Thermocouple/Thermopile Amplifiers
- ❑ Load Cell and Bridge Transducer Amplifiers
- ❑ Precision Instrumentation
- ❑ Battery-powered Systems

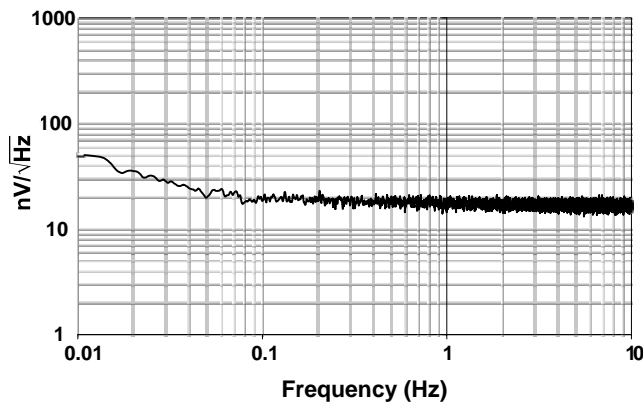
Description

The CS3004 dual amplifier is designed for precision amplification of low-level signals. These amplifiers achieve excellent offset stability, high open loop gain, and low noise. The devices also exhibit excellent CMRR and PSRR. The common mode input range includes the supply rails. The amplifiers operate with any supply voltage from 2.7 V to 5 V (± 1.35 V to ± 2.50 V).

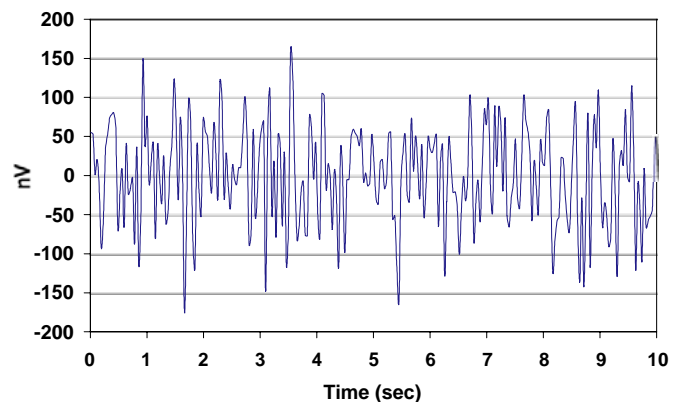
Pin Configurations



1. Must not be connected.
2. Connect thermal die pad to V-.



Noise vs. Frequency (Measured)



0.01 Hz to 10 Hz Noise Performance

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Contacting Cirrus Logic Support

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1. CHARACTERISTICS AND SPECIFICATIONS

1.1 5 V Electrical Characteristics

V+ = +5 V, ±5%; V- = 0V; VCM = 2.5 V; Unless otherwise noted, T_A = 25° C (See Note 1).

| Parameter | | Min | Typ | Max | Unit |
|----------------------------------|------------------------------------------------|--------------|-------|------------|-------------------|
| Input Offset Voltage | (Note 2) | • - | ±2 | ±10 | μV |
| Average Input Offset Drift | (Note 2) | • - | ±0.01 | ±0.05 | μV/°C |
| Input Bias Current | | • - | ±170 | ±250 | pA |
| | | • - | - | ±1.5 | nA |
| Input Offset Current | | • - | ±340 | ±500 | pA |
| | | • - | - | ±3.0 | nA |
| Input Noise Voltage Density | R _S = 100 Ω, f ₀ = 1 Hz | - | 17 | - | nV/√Hz |
| | R _S = 100 Ω, f ₀ = 1 kHz | - | 17 | - | nV/√Hz |
| Input Noise Voltage | 0.1 to 10 Hz | - | 350 | - | nV _{p-p} |
| Input Noise Current Density | f ₀ = 1 Hz | - | 100 | - | fA/√Hz |
| Input Noise Current | 0.1 to 10 Hz | - | 1.9 | - | pA _{p-p} |
| Input Voltage Range | (Note 2) | • V- | - | V+ | V |
| Common Mode Rejection Ratio (dc) | | • 110 | 120 | - | dB |
| Power Supply Rejection Ratio | | • 110 | 130 | - | dB |
| Large Signal Voltage Gain | | - | 150 | - | dB |
| | (Note 3) R _L = 2 kΩ to V+/2 | • 120 | 150 | - | dB |
| Output Voltage Swing | R _L = 2 kΩ to V+/2 | • (V+ - 100) | - | (V- + 100) | mV |
| | (Note 4) R _L = 100 kΩ to V+/2 | • (V+ - 10) | - | (V- + 10) | mV |
| Slew Rate | R _L = 2 k, 100 pF | | 0.25 | - | V/μs |
| Overload Recovery Time | | - | 25 | - | μs |
| Supply Current | | • - | 2.0 | 2.5 | mA |
| Oscillator Frequency | | - | 150 | - | kHz |
| Input Capacitance | Differential | - | 1.5 | - | pF |
| | Common Mode | - | 10 | - | pF |

- Notes:
1. Symbol “•” denotes specification applies over -40 to +125 ° C.
 2. This parameter is guaranteed by design and/or laboratory characterization.
 3. Guaranteed within the output limits of (V+ - 0.2 V) to (V- + 0.2 V).
 4. Specifies the worst case drive voltage relative to the supply rail under stated load conditions.

1.2 3 V Electrical Characteristics

V+ = +3 V, ±10%; V- = 0V; VCM = 1.5 V; Unless otherwise noted, T_A = 25° C (See Note 5).

| Parameter | | Min | Typ | Max | Unit |
|----------------------------------|------------------------------------------------|--------------|-------|------------|-------------------|
| Input Offset Voltage | (Note 6) | • - | ±2 | ±10 | μV |
| Average Input Offset Drift | (Note 6) | • - | ±0.01 | ±0.05 | μV/°C |
| Input Bias Current | | • - | ±110 | ±150 | pA |
| | | • - | - | ±1.0 | nA |
| Input Offset Current | | • - | ±220 | ±300 | pA |
| | | • - | - | ±2.0 | nA |
| Input Noise Voltage Density | R _S = 100 Ω, f ₀ = 1 Hz | - | 17 | - | nV/√Hz |
| | R _S = 100 Ω, f ₀ = 1 kHz | - | 17 | - | nV/√Hz |
| Input Noise Voltage | 0.1 to 10 Hz | - | 350 | - | nV _{p-p} |
| Input Noise Current Density | f ₀ = 1 Hz | - | 100 | - | fA/√Hz |
| Input Noise Current | 0.1 to 10 Hz | - | 1.9 | - | pA _{p-p} |
| Input Voltage Range | (Note 6) | • V- | - | V+ | V |
| Common Mode Rejection Ratio (dc) | | • 110 | 120 | - | dB |
| Power Supply Rejection Ratio | | • 110 | 130 | - | dB |
| Large Signal Voltage Gain | | - | 160 | - | dB |
| | (Note 7) R _L = 2 kΩ to V+/2 | • 120 | 150 | - | dB |
| Output Voltage Swing | R _L = 2 kΩ to V+/2 | • (V+ - 100) | - | (V- + 100) | mV |
| | (Note 8) R _L = 100 kΩ to V+/2 | (V+ - 10) | - | (V- + 10) | mV |
| Slew Rate | R _L = 2 k, 100 pF | | 0.25 | - | V/μs |
| Overload Recovery Time | | - | 25 | - | μs |
| Supply Current | | • - | 2.0 | 2.5 | mA |
| Oscillator Frequency | | - | 150 | - | kHz |
| Input Capacitance | Differential | - | 1.5 | - | pF |
| | Common Mode | - | 10 | - | pF |

Notes: 5. Symbol “•” denotes specification applies over -40 to +125 ° C.

6. This parameter is guaranteed by design and/or laboratory characterization.

7. Guaranteed within the output limits of (V+ - 0.2 V) to (V- + 0.2 V).

8. Specifies the worst case drive voltage relative to the supply rail under stated load conditions.

1.3 Absolute Maximum Ratings

| Parameter | Min | Typ | Max | Unit |
|------------------------------|------------|-----|------------|------|
| Supply Voltage [(V+) – (V-)] | 2.7 | - | 5.5 | V |
| Input Voltage | (V-) – 0.3 | - | (V+) + 0.3 | V |
| Storage Temperature Range | -65 | - | +150 | °C |

2. TYPICAL PERFORMANCE PLOTS

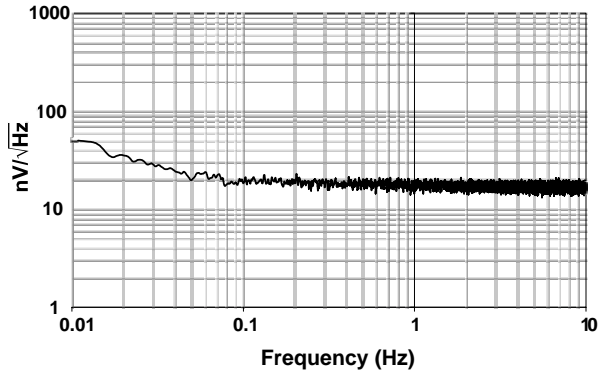


Figure 1. Noise vs Frequency (Measured)

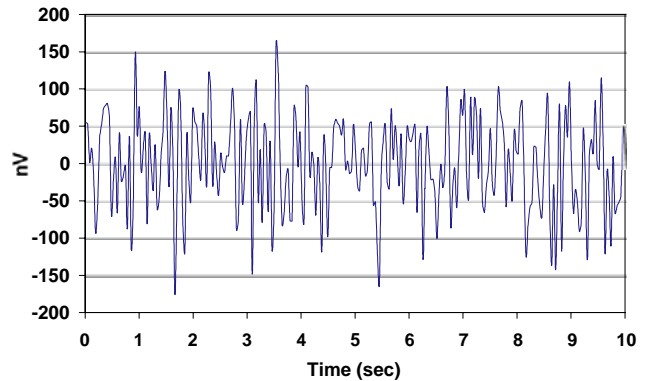


Figure 2. 0.01 Hz to 10 Hz Noise

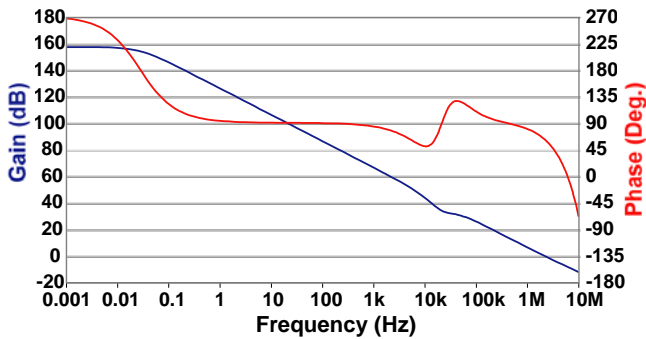


Figure 3. Gain & Phase vs. Frequency (2.7 V)

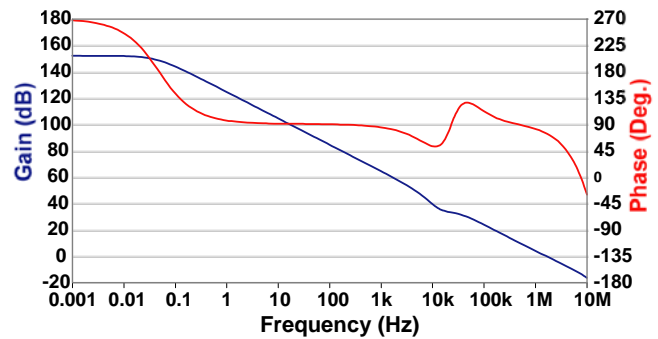


Figure 4. Gain & Phase vs. Frequency (5 V)

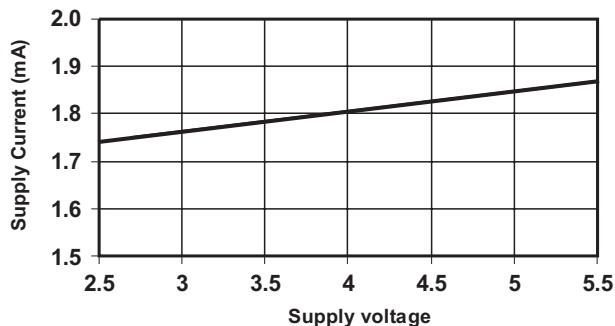


Figure 5. Supply Current vs. Supply Voltage

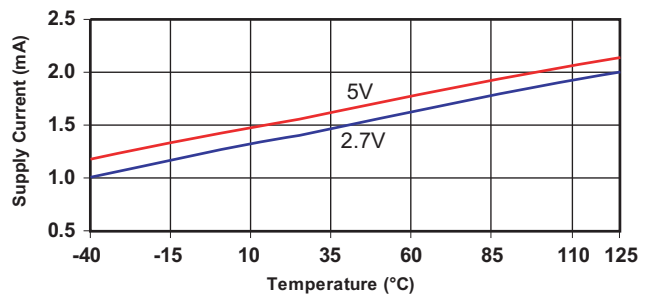
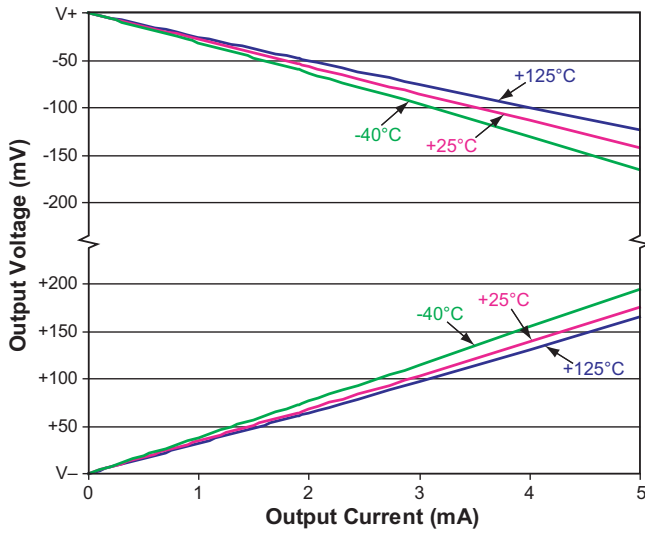
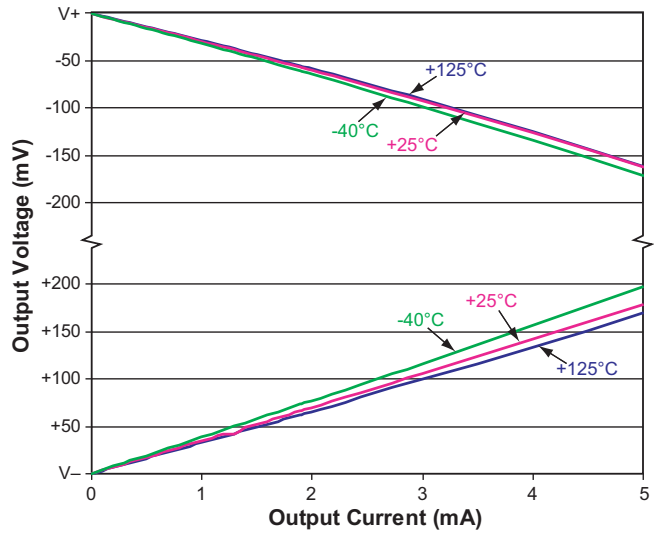
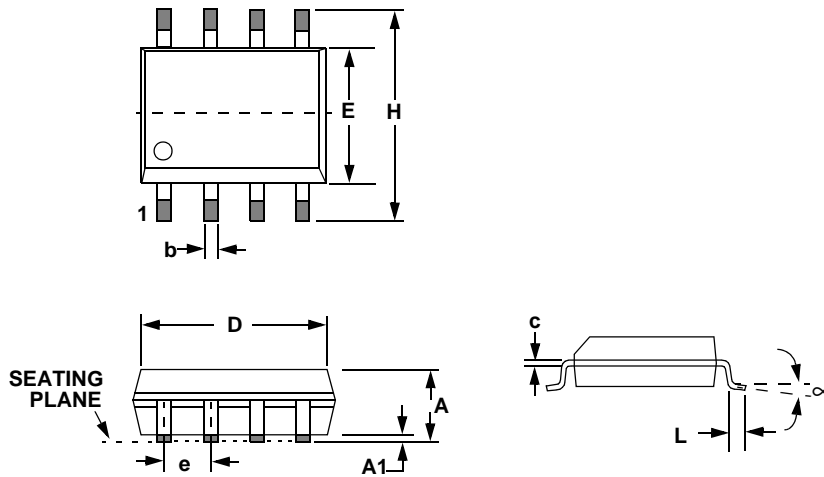


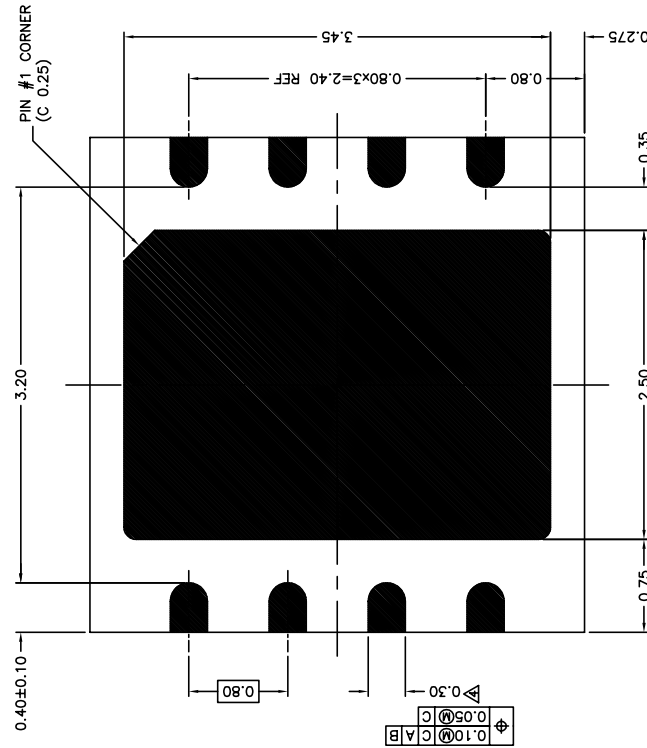
Figure 6. Supply Current vs. Temperature

Typical Performance Plots (Cont.)

Figure 7. Voltage Swing vs. Output Current (2.7 V)

Figure 8. Voltage Swing vs. Output Current (5 V)
3. PACKAGE DRAWINGS
8L SOIC (150 MIL BODY) PACKAGE DRAWING


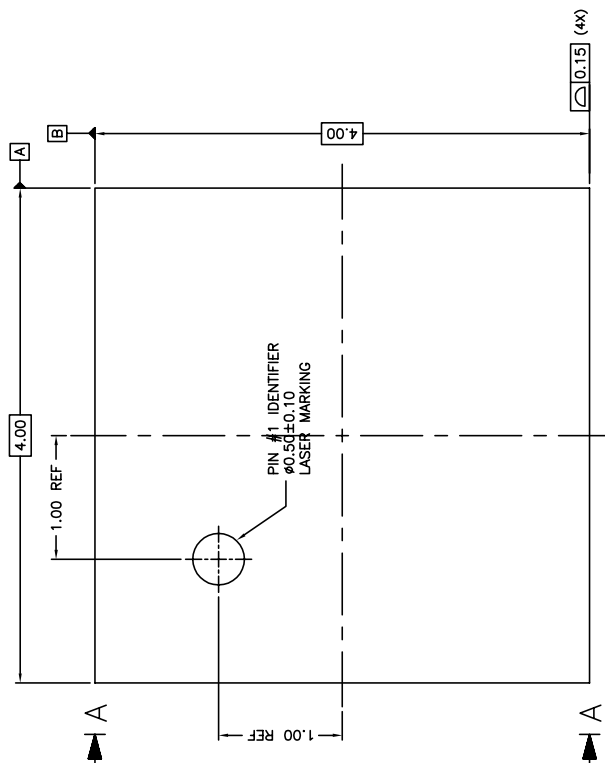
| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|------|
| | MIN | MAX | MIN | MAX |
| A | 0.053 | 0.069 | 1.35 | 1.75 |
| A1 | 0.004 | 0.010 | 0.10 | 0.25 |
| B | 0.013 | 0.020 | 0.33 | 0.51 |
| C | 0.007 | 0.010 | 0.19 | 0.25 |
| D | 0.189 | 0.197 | 4.80 | 5.00 |
| E | 0.150 | 0.157 | 3.80 | 4.00 |
| e | 0.040 | 0.060 | 1.02 | 1.52 |
| H | 0.228 | 0.244 | 5.80 | 6.20 |
| L | 0.016 | 0.050 | 0.40 | 1.27 |
| ∞ | 0° | 8° | 0° | 8° |

JEDEC # : MS-012

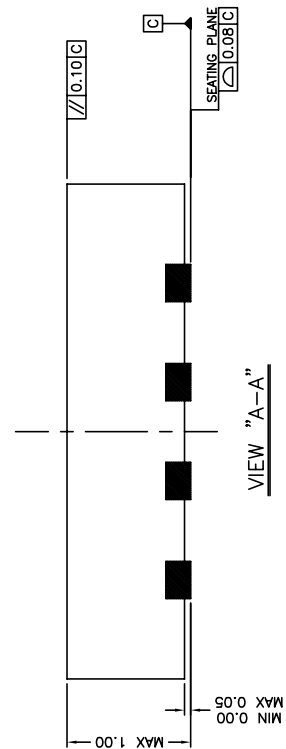
8L QFN (4 mm X 4 mm) PACKAGE DRAWING



- NOTE)
1. CONTROLLING DIMENSIONS ARE IN MM.
 2. UNLESS OTHERWISE SPECIFIED TOLERANCE : DECIMAL ± 0.05 ANGULAR $\pm 2^\circ$
 3. DIMENSIONING AND TOLERANCE PER ASME Y 14.5M - 1994.
- A** DIMENSION LEAD WIDTH APPLIES TO THE PLATED TERMINAL AND IS MEASURED BETWEEN 0.28MM AND 0.33MM FROM THE TERMINAL TIP.



TOP VIEW



4. ORDERING INFORMATION

| Part # | Temperature Range | Package Description |
|-------------|-------------------|------------------------|
| CS3004-FS | -40 °C to +125 °C | 8-lead SOIC |
| CS3004-FSZ | -40 °C to +125 °C | 8-lead SOIC, Lead Free |
| CS3004-FNZ* | -40 °C to +125 °C | 8-lead QFN, Lead Free |

* Connect thermal die pad to V-.

5. ENVIRONMENTAL, MANUFACTURING, & HANDLING INFORMATION

| Model Number | Peak Reflow Temp | MSL Rating* | Max Floor Life |
|--------------|------------------|-------------|----------------|
| CS3004-FS | 240 °C | 2 | 365 Days |
| CS3004-FSZ | 260 °C | | |
| CS3004-FNZ | | | |

* MSL (Moisture Sensitivity Level) as specified by IPC/JEDEC J-STD-020.

6. REVISION HISTORY

| Revision | Date | Changes |
|----------|----------|-------------------------------------|
| PP4 | FEB 2007 | First public release. |
| F1 | AUG 2007 | Updated to "Final" per QPL process. |