### 1.0 SCOPE

This specification documents the detail requirements for space qualified product manufactured on Analog Devices, Inc.'s QML certified line per MIL-PRF-38535 Level V except as modified herein.
The manufacturing flow described in the STANDARD SPACE LEVEL PRODUCTS PROGRAM brochure is to be considered a part of this specification. http://www.analog.com/aerospace

This data sheet specifically details the space grade version of this product. A more detailed operational description and a complete data sheet for commercial product grades can be found at www.analog.com/AD847
2.0 Part Number. The complete part number(s) of this specification follow:

## Part Number

AD847-703Q

### 2.1 Case Outline.

Letter
Descriptive designator
Q GDIP1-T8

AD847-713Q Radiation Tested, High speed, low power, operational amplifier

## Description

High speed, low power, operational amplifier

Case Outline (Lead Finish per MIL-PRF-38535)
8 -Lead ceramic dual-in-line package (CERDIP)


Figure 1 - Terminal connections.
3.0 Absolute Maximum Ratings. $\left(\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}\right.$, unless otherwise noted)
Supply voltage $\pm 18$ V
Differential input voltage ............................................................................................. $\pm 6 \mathrm{~V}$
Input common mode voltage ......................................................................................... $\pm \mathrm{V}_{\mathrm{S}}$
Operating temperature range..................................................................... $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Storage temperature range ....................................................................... $-65^{\circ} \mathrm{C}$ to $+150^{\circ} \mathrm{C}$
Power dissipation ( $\mathrm{P}_{\mathrm{D}}$ ) .1.1W
Lead temperature (soldering, 10 seconds) .............................................................. $+300^{\circ} \mathrm{C}$
Thermal resistance, junction-to-case ( $\theta_{\text {JC }}$ ) .......................................... See MIL-STD-1835
Thermal resistance, junction-to-ambient $\left(\theta_{\mathrm{JA}}\right)$.......................................... $110^{\circ} \mathrm{C} / \mathrm{W}$
Junction temperature $\left(\mathrm{T}_{\mathrm{J}}\right)$........................................................................... $+175^{\circ} \mathrm{C}$
4.0 Electrical Table: See notes at end of table

| Table I |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Parameter | Symbol | Conditions 1/ | Subgroup | $\frac{2 /}{\text { Min }}$ | $\frac{2 /}{M a x}$ | Units |
| Input offset voltage | $\mathrm{V}_{\text {IO }}$ |  | 1 |  | $\pm 1.0$ | mV |
|  |  |  | 2, 3 |  | $\pm 4.0$ |  |
| Input bias current | $\mathrm{I}_{\mathrm{B}}$ | $\overline{\mathrm{V}_{\mathrm{S}}}= \pm 5 \mathrm{~V}, \pm 15 \mathrm{~V}$ | 1 |  | 5.0 | $\mu \mathrm{A}$ |
|  |  |  | 2, 3 |  | 7.5 |  |
| Input offset current | $\mathrm{I}_{\mathrm{IO}}$ |  | 1 |  | $\pm 300$ | nA |
|  |  |  | 2, 3 |  | $\pm 400$ |  |
| Common mode input voltage range 3/ | IVR |  | 1, 2, 3 |  | $\pm 2.5$ | V |
|  |  | $\mathrm{V}_{\mathrm{S}}= \pm 15 \mathrm{~V}$ | 1, 2, 3 |  | $\pm 12$ |  |
| Open loop gain | AVO | $\mathrm{V}_{\text {OUT }}= \pm 2.5 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=500 \Omega$ | 1 | 2.0 |  | $\mathrm{V} / \mathrm{mV}$ |
|  |  |  | 2, 3 | 1.0 |  |  |
|  |  | $\mathrm{V}_{\text {OUT }}= \pm 10 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=1 \mathrm{k} \Omega, \mathrm{V}_{\mathrm{S}}= \pm 15 \mathrm{~V}$ | 1 | 3.0 |  |  |
|  |  |  | 2, 3 | 1.5 |  |  |
| Common mode rejection ratio | CMRR | $\begin{aligned} & \mathrm{V}_{\mathrm{CM}}= \pm 2.5 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{CM}}= \pm 12 \mathrm{~V}, \mathrm{~V}_{\mathrm{S}}= \pm 15 \mathrm{~V} \end{aligned}$ | 1 | 80 |  | dB |
|  |  |  | 1 | 80 |  |  |
|  |  |  | 2, 3 | 75 |  |  |
| Output current 4/ | $\mathrm{I}_{\text {OUT }}$ | $\mathrm{V}_{\text {OUT }}= \pm 2.5 \mathrm{~V}$ | 4 | 13 |  | mA |
|  |  | $\mathrm{V}_{\text {OUT }}= \pm 10 \mathrm{~V}, \mathrm{~V}_{\mathrm{S}}= \pm 15 \mathrm{~V}$ | 4 | 20 |  |  |
| Output voltage swing | $+\mathrm{V}_{\text {OUT }}$ | $\mathrm{R}_{\mathrm{L}}=500 \Omega$ | 1 | 3.0 |  | V |
|  |  |  | 2, 3 | 2.5 |  |  |
|  |  | $\mathrm{R}_{\mathrm{L}}=150 \Omega$ | 1 | 2.5 |  |  |
|  |  | $\mathrm{V}_{\mathrm{S}}= \pm 15 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=1 \mathrm{k} \Omega$ | 1, 2, 3 | 12 |  |  |
|  |  | $\mathrm{V}_{\mathrm{S}}= \pm 15 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=500 \Omega$ | 1 | 10 |  |  |
|  | - $\mathrm{V}_{\text {OUT }}$ | $\mathrm{R}_{\mathrm{L}}=500 \Omega$ | 1 | -3.0 |  |  |
|  |  |  | 2, 3 | -2.5 |  |  |
|  |  | $\mathrm{R}_{\mathrm{L}}=150 \Omega$ | 1 | -2.5 |  |  |
|  |  | $\mathrm{V}_{\mathrm{S}}= \pm 15 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=1 \mathrm{k} \Omega$ | 1, 2, 3 | -12 |  |  |
|  |  | $\mathrm{V}_{\mathrm{S}}= \pm 15 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=500 \Omega$ | 1 | -10 |  |  |
| Quiescent power supply current | $\mathrm{I}_{\mathrm{CC}}$ |  | 1 |  | 5.7 | mA |
|  |  |  | 2, 3 |  | 7.8 |  |
|  |  | $\mathrm{V}_{\mathrm{S}}= \pm 15 \mathrm{~V}$ | 1 |  | 6.3 |  |
|  |  |  | 2, 3 |  | 8.4 |  |
| Power supply rejection ratio | PSRR | $\mathrm{V}_{\mathrm{S}}= \pm 5 \mathrm{~V}$ to $\pm 15 \mathrm{~V}$ | 1 | 75 |  | dB |
|  |  |  | 2, 3 | 72 |  |  |
| Differential input resistance 4/ | $\mathrm{R}_{\text {IN }}$ | $\mathrm{V}_{\mathrm{S}}= \pm 5 \mathrm{~V}, \pm 15 \mathrm{~V}$ | 4 | 80 |  | $\mathrm{k} \Omega$ |


| Table I |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Parameter | Symbol | Conditions 1/ | $\begin{aligned} & \text { Sub- } \\ & \text { group } \end{aligned}$ | $\begin{array}{r} \frac{21}{} \\ \text { Min } \end{array}$ | $\frac{2 /}{\operatorname{Max}}$ | Units |
| Slew rate 6/ 4/ | +SR | $\mathrm{V}_{\text {out }}=-2.5 \mathrm{~V} \text { to }+2.5 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=$ <br> $500 \Omega, \mathrm{~A}_{\mathrm{V}}=1 \mathrm{~V} / \mathrm{V}$, <br> Measured from $10 \%$ to $90 \%$ | 4 | 120 |  | V/ $\mu \mathrm{S}$ |
|  |  |  | 5, 6 | 90 |  |  |
|  | -SR | $\begin{aligned} & \mathrm{V}_{\text {OuT }}=+2.5 \mathrm{~V} \text { to }-2.5 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}= \\ & 500 \Omega, \mathrm{~A}_{\mathrm{V}}=1 \mathrm{~V} / \mathrm{V}, \end{aligned}$$\text { Measured from } 10 \% \text { to } 90 \%$ | 4 | 90 |  |  |
|  |  |  | 5, 6 | 65 |  |  |
|  | +SR | $\begin{aligned} & \mathrm{V}_{\text {out }}=-5 \mathrm{~V} \text { to }+5 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=1 \mathrm{~K} \Omega, \\ & \mathrm{~V}_{\mathrm{S}}= \pm 15 \mathrm{~V} \end{aligned}$ | 4 | 200 |  |  |
|  |  | Measured from $10 \%$ to $90 \%$ | 5,6 | 130 |  |  |
|  | -SR | $\begin{aligned} & \mathrm{V}_{\text {OUT }}=+5 \mathrm{~V} \text { to }-5 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=1 \mathrm{~K} \Omega, \\ & \mathrm{~V}_{\mathrm{S}}= \pm 15 \mathrm{~V} \end{aligned}$ | 4 | 145 |  |  |
|  |  | Measured from $10 \%$ to $90 \%$ | 5,6 | 120 |  |  |
| Gain bandwidth product 4/ | GBWP | $\mathrm{V}_{\text {OUT }}= \pm 100 \mathrm{mV}, \mathrm{R}_{\mathrm{L}}-500 \Omega$ | 4 | 25 |  | MHz |
|  |  | $\begin{aligned} & \mathrm{V}_{\text {out }}= \pm 100 \mathrm{mV}, \mathrm{R}_{\mathrm{L}}=1 \mathrm{~K} \Omega, \mathrm{VS} \\ & = \pm 15 \mathrm{~V} \end{aligned}$ |  | 40 |  |  |
| Full power bandwidth 4/ | FPBW | $\mathrm{V}_{\mathrm{PK}}=2.5 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=500 \Omega$ | 4 | 5.7 |  |  |
|  |  | $\begin{aligned} & \mathrm{V}_{\mathrm{PK}}=10 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=1 \mathrm{~K} \Omega, \mathrm{~V}_{\mathrm{S}}= \\ & \pm 15 \mathrm{~V} \end{aligned}$ |  | 2.8 |  |  |
| Closed loop stable gain 4/ | CLSG | $\mathrm{R}_{\mathrm{L}}=1 \mathrm{~K} \Omega, \mathrm{~V}_{\mathrm{S}}= \pm 5 \mathrm{~V}, \pm 15 \mathrm{~V}$ | 4, 5, 6 | 1.0 |  | V/V |
| Rise time 4/ 8/ | $\mathrm{r}_{\mathrm{r}}$ | $\begin{aligned} & \mathrm{V}_{\text {out }}=0 \mathrm{~V} \text { to }+200 \mathrm{mV}, \mathrm{~A}_{\mathrm{V}}=+1, \\ & \mathrm{R}_{\mathrm{L}}=-1 \mathrm{~K} \Omega, \mathrm{~V}_{\mathrm{S}}= \pm 15 \mathrm{~V} \end{aligned}$ | 4, 5, 6 |  | 10 | nS |
|  | $\mathrm{t}_{\mathrm{f}}$ | $\begin{aligned} & \mathrm{V}_{\text {OUT }}=0 \mathrm{~V} \text { to }-200 \mathrm{mV}, \mathrm{~A}_{\mathrm{V}}=+1, \\ & \mathrm{R}_{\mathrm{L}}=-1 \mathrm{~K} \Omega, \mathrm{~V}_{\mathrm{S}}= \pm 15 \mathrm{~V} \end{aligned}$ | 4, 5, 6 |  | 10 |  |
| Settling time 4 / | $\mathrm{t}_{\text {s }}$ | $\mathrm{A}_{\mathrm{V}}=-1 \mathrm{~V} / \mathrm{V}, 10 \mathrm{~V}$ step at $0.1 \%$ of the fixed value, $\mathrm{R}_{\mathrm{L}}=1 \mathrm{~K} \Omega$ |  |  | 150 |  |
|  |  | $\mathrm{A}_{\mathrm{V}}=-1 \mathrm{~V} / \mathrm{V}, 10 \mathrm{~V}$ step at $0.01 \%$ of the fixed value, $\mathrm{R}_{\mathrm{L}}=1 \mathrm{~K} \Omega$ |  |  | 200 |  |
| Overshoot 4/ | +OS | $\begin{aligned} & \text { V } \begin{array}{l} \text { Out }=0 \mathrm{~V} \text { to }+200 \mathrm{mV}, \mathrm{~A}_{\mathrm{V}}=+1, \\ \mathrm{R}_{\mathrm{L}}=1 \mathrm{~K} \Omega, \mathrm{~V}_{\mathrm{S}}= \pm 15 \mathrm{~V} \end{array} \\ & \hline \end{aligned}$ | 4 |  | 30 | \% |
|  | -OS | $\begin{aligned} & \mathrm{V}_{\text {OUT }}=0 \mathrm{~V} \text { to }-200 \mathrm{mV}, \mathrm{~A}_{\mathrm{V}}=+1, \\ & \mathrm{R}_{\mathrm{L}}=1 \mathrm{~K} \Omega, \mathrm{~V}_{\mathrm{S}}= \pm 15 \mathrm{~V} \end{aligned}$ | 4 |  | 30 |  |

## TABLE I NOTES:

1/ Unless otherwise specified for dc tests, $\mathrm{V}_{\mathrm{S}}= \pm 5 \mathrm{~V}, \mathrm{R}_{\mathrm{S}}<100 \Omega, \mathrm{R}_{\mathrm{L}}>100 \mathrm{k} \Omega$, $\mathrm{V}_{\text {OuT }}=0 \mathrm{~V}$, and $\mathrm{C}_{\mathrm{L}} \leq 10 \mathrm{pF}$. Unless otherwise specified for ac tests, $\mathrm{A}_{\mathrm{V}}= \pm 1 \mathrm{~V} / \mathrm{V}, \mathrm{R}_{\mathrm{L}}=1 \mathrm{k} \Omega$, and $\mathrm{C}_{\mathrm{L}}=10 \mathrm{pF}$.
2/ The limiting terms "min" (minimum) and "max" (maximum) shall be considered to apply to magnitudes only. Negative current shall be defined as conventional current flow out of a device terminal.
3/ This parameter is guaranteed by CMRR test.
4/ If not tested, shall be guaranteed to the limits specified in table I herein.
5/ Quiescent power consumption is based on quiescent supply current test maximum (no load at the output).
6/ Slew rate test limits are guarantee after 5 minutes of warm-up.
7/ Full power bandwidth $=\mathrm{SR} /\left(2 \pi \mathrm{~V}_{\mathrm{PK}}\right)$.
8/ Rise and fall times measured between $10 \%$ and $90 \%$ point.

### 4.1 Electrical Test Requirements:

| Table II |  |
| :--- | :--- |
| Test Requirements |  |
| Interim Electrical Parameters | Subgroups (in accordance <br> with MIL-PRF-38535, <br> Table III) |
| Final Electrical Parameters | 1 |
| Group A Test Requirements | $1,2,3,4,5,6 \quad \underline{/ /} \quad \underline{2 /}$ |
| Group C end-point electrical parameters | $1, \underline{2} /$ |
| Group D end-point electrical parameters | 1 |
| Group E end-point electrical parameters | 1 |

1/ PDA applies to Subgroup 1. Delta's excluded from PDA.
2/ See Table III for delta parameters. See table I for conditions.

### 4.2 Table III. Burn-in test delta limits.

| Table III |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| TEST | BURN-IN | LIFETEST | DELTA |  |
| TITLE | ENDPOINT | ENDPOINT | LIMIT | UNITS |
| $\mathrm{V}_{\mathrm{OS}}$ | $\pm 1$ | $\pm 1.5$ | $\pm 0.5$ | mV |
| $\pm \mathrm{I}_{\mathrm{B}}$ | 5 | 7.5 | 2.5 | $\mu \mathrm{~A}$ |
| $\mathrm{I}_{\mathrm{IO}}$ | $\pm 300$ | $\pm 500$ | $\pm 200$ | nA |

### 5.0 Life Test/Burn-In Circuit:

5.1 HTRB is not applicable for this drawing.
5.2 Burn-in is per MIL-STD-883 Method 1015 test condition B.
5.3 Steady state life test is per MIL-STD-883 Method 1005.

| Rev | Description of Change | Date |
| :---: | :--- | :---: |
| A | Initiate | July 20, 2000 |
| B | Update web address | Feb. 7, 2002 |
| C | Update web address. Delete Burn-In circuit. | June 20, 2003 |
| D | Update header/footer \& add to 1.0 scope description. | Feb. 25, 2008 |
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