| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | DATE (YR-MO-DA) | APPROVED |
| A | Add case outline X. Technical and editorial changes throughout. | 94-03-07 | M. A. FRYE |
| B | Change load regulation conditions in table I. Technical and editorial changes throughout. - lgt | 98-05-11 | R. MONNIN |
| C | Make change to oscillator frequency test as specified under table I herein. - ro | 99-04-28 | R. MONNIN |
| D | Make change to 1.2.2 and subgroup 4 of oscillator frequency test as specified under table I herein. - ro | 99-09-30 | R. MONNIN |

THE ORIGINAL SHEET OF THIS DRAWING HAS BEEN REPLACED.

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REV | | | | | | | | | | | | | | | | | | | | |
| SHEET | | | | | | | | | | | | | | | | | | | | |
| REV | | | | | | | | | | | | | | | | | | | | |
| SHEET | | | | | | | | | | | | | | | | | | | | |
| REV STATUS | | | | REV | | | D | D | D | D | D | D | D | D | D | | | | | |
| OF SHEETS | | | | SHEET | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | | | | |

PMIC N/A

PREPARED BY
GARY ZAHN

DEFENSE SUPPLY CENTER COLUMBUS
COLUMBUS, OHIO 43216

STANDARD MICROCIRCUIT DRAWING

CHECKED BY
CHARLES E. BESORE

THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE

APPROVED BY
WILLIAM K. HECKMAN

MICROCIRCUIT, LINEAR, SWITCHED CAPACITOR VOLTAGE CONVERTER WITH,

REGULATOR, MONOLITHIC SILICON

DRAWING APPROVAL DATE
89-08-16

AMSC N/A

| REVISION LEVEL | SIZE | CAGE CODE | |
|---|---|---|---|
| D | A | 67268 | 5962-89562 |

SHEET 1 OF 9

DSCC FORM 2233
APR 97

5962-E484-99

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

1. SCOPE

1.1 Scope. This drawing describes device requirements for MIL-STD-883 compliant, non-JAN class level B microcircuits in accordance with MIL-PRF-38535, appendix A.

1.2 Part or Identifying Number (PIN). The complete PIN is as shown in the following example:

| 5962-89562 | 01 | P | X |
|---|---|---|---|
| * | * | * | * |
| * | * | * | * |
| * | * | * | * |
| * | * | * | * |
| Drawing number | Device type (see 1.2.1) | Case outline (see 1.2.2) | Lead finish (see 1.2.3) |

1.2.1 Device type(s). The device type(s) identify the circuit function as follows:

| Device type | Generic number | Circuit function |
|---|---|---|
| 01 | LT1054M | Switched capacitor voltage converter with regulator |

1.2.2 Case outline(s). The case outline(s) are as designated in MIL-STD-1835 and as follows:

| Outline letter | Descriptive designator | Terminals | Package style |
|---|---|---|---|
| G | MACY1-X8 | 8 | Can |
| P | GDIP1-T8 or CDIP2-T8 | 8 | Dual-in-line |
| X | See figure 1 | 8 | TO-257 can with isolated tab and glass sealed |

1.2.3 Lead finish. The lead finish is as specified in MIL-PRF-38535, appendix A.

1.3 Absolute maximum ratings.

Supply voltage range (V+) ..... 16 V dc 1/
Input voltage range (pin 1) ..... 0 V dc ≤ $V_{PIN1}$ ≤ V+
Input voltage range (pin 7) ..... 0 V dc ≤ $V_{PIN7}$ ≤ $V_{REF}$
Lead temperature (soldering, 10 seconds) ..... +300°C
Junction temperature ($T_J$) ..... +150°C
Thermal resistance, junction-to-case ($\theta_{JC}$) ..... See MIL-STD-1835
Thermal resistance, junction-to-ambient ($\theta_{JA}$):
  Cases G and X ..... 150°C/W
  Case P ..... 100°C/W

1.4 Recommended operating conditions.

Supply voltage range ..... 3.5 V dc to 15 V dc
Ambient operating temperature range ($T_A$) ..... -55°C to +125°C

1/ Rating is for regulated circuits. For regulation mode circuits with $V_{OUT}$ ≤ 15 V at $V_{OUT}$ pin, this rating may be increased to 20 V dc.

2. APPLICABLE DOCUMENTS

2.1 Government specification, standards, and handbooks. The following specification, standards, and handbooks form a part of this drawing to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-38535 - Integrated Circuits, Manufacturing, General Specification for.

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-883 - Test Method Standard Microcircuits.
MIL-STD-973 - Configuration Management.
MIL-STD-1835 - Interface Standard For Microcircuit Case Outlines.

HANDBOOKS

DEPARTMENT OF DEFENSE

MIL-HDBK-103 - List of Standard Microcircuit Drawings (SMD's).
MIL-HDBK-780 - Standard Microcircuit Drawings.

(Unless otherwise indicated, copies of the specification, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this drawing and the references cited herein, the text of this drawing takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Item requirements. The individual item requirements shall be in accordance with MIL-PRF-38535, appendix A for non-JAN class level B devices and as specified herein. Product built to this drawing that is produced by a Qualified Manufacturer Listing (QML) certified and qualified manufacturer or a manufacturer who has been granted transitional certification to MIL-PRF-38535 may be processed as QML product in accordance with the manufacturers approved program plan and qualifying activity approval in accordance with MIL-PRF-38535. This QML flow as documented in the Quality Management (QM) plan may make modifications to the requirements herein. These modifications shall not affect form, fit, or function of the device. These modifications shall not affect the PIN as described herein. A "Q" or "QML" certification mark in accordance with MIL-PRF-38535 is required to identify when the QML flow option is used.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38535, appendix A and herein.

3.2.1 Case outline(s). The case outline(s) shall be in accordance with 1.2.2 herein and figure 1.

3.2.2 Terminal connections. The terminal connections shall be as specified on figure 2.

3.3 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in table I and shall apply over the full ambient operating temperature range.

TABLE I. Electrical performance characteristics.

| Test | Symbol | Conditions<br>$-55°C \le T_A \le +125°C$<br>unless otherwise specified | Group A subgroups | Device type | Limits | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | |
| Supply current | $I_{CC}$ | $I_{LOAD}$ = 0 mA, $V_{IN}$ = 3.5 V | 1,2,3 | 01 | | 4 | mA |
| | | $I_{LOAD}$ = 0 mA, $V_{IN}$ = 15 V | | | | 5 | |
| Voltage loss 1/ | $V_{IN}$ - $V_{OUT}$ | $C_{IN} = C_{OUT}$ = 100 µF tantalum, $I_{OUT}$ = 10 mA | 1,2,3 | 01 | | 0.55 | V |
| | | $C_{IN} = C_{OUT}$ = 100 µF tantalum, $I_{OUT}$ = 100 mA | | | | 1.60 | |
| Output resistance 2/ 3/ | $R_{OUT}$ | $\Delta I_{OUT}$ = 10 mA to 100 mA | 4,5,6 | 01 | | 15 | Ω |
| Oscillator frequency | $f_{OSC}$ | 3.5 V ≤ $V_{IN}$ ≤ 15 V | 4,5,6 | 01 | 15 | 40 | kHz |
| Reference voltage | $V_{REF}$ | $I_{REF}$ = 60 µA | 1 | 01 | 2.35 | 2.65 | V |
| | | | 2,3 | | 2.25 | 2.75 | |
| Regulated voltage 2/ 4/ | $V_{REG}$ | $V_{IN}$ = 7.0 V | 1,2,3 | 01 | -4.70 | -5.20 | V |
| Line regulation 4/ | $V_{RLINE}$ | 7.0 V ≤ $V_{IN}$ ≤ 12 V | 1,2,3 | 01 | | 25 | mV |
| Load regulation 4/ | $V_{RLOAD}$ | $V_{IN}$ = 7.0 V,<br>100 Ω ≤ $R_L$ ≤ 500 Ω | 1,2,3 | 01 | | 50 | mV |
| Supply current in shutdown | $I_{SHDN}$ | $V_{PIN1}$ = 0 V | 1,2,3 | 01 | | 200 | µA |

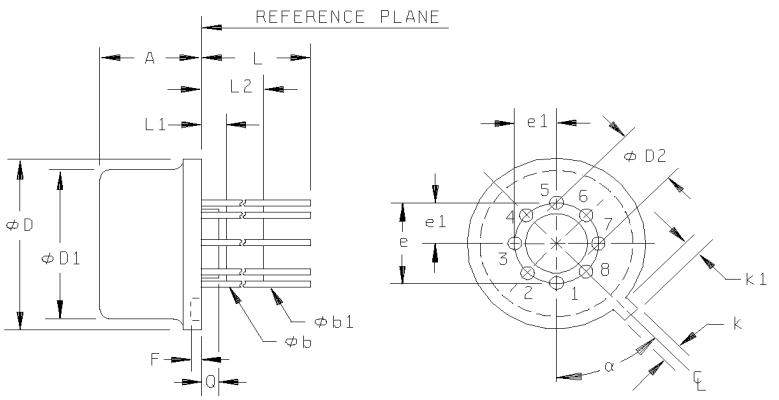
1/ The voltage loss tests are done on a dc basis. The voltage loss is measured for each individual switch then summed to get the total voltage loss. Each switch is tested at two current levels. The switch current levels are chosen to correlate to a device operating as a voltage inverter, with pins 1, 6, and 7 unconnected. To simulate the loss of a running device at 10 mA load, the switches are loaded with 24 mA. To simulate a device running at 100 mA load, the switches are loaded with 240 mA. Switches are turned on in pairs, but the voltage loss is measured across each switch of the pair.

2/ If not tested, subgroups 2, 3, 5, and 6 shall be guaranteed to the limits specified in table I.

3/ Output resistance is defined as the slope of the curve, ($\Delta V_{OUT}$ vs $\Delta I_{OUT}$), for output currents of 10 mA to 100 mA. This represents the linear portion of the curve. The incremental slope of the curve will be higher at currents < 10 mA due to the characteristics of the switch transistors.

4/ All regulation specifications are for a device connected as a positive to negative converter/regulator with $R_1$ = 20 kΩ, $R_2$ = 102.5 kΩ, $C_1$ = 0.05 µF, $C_{IN}$ = 10 µF tantalum, and $C_{OUT}$ = 100 µF tantalum. Regulation tests are actually done using an RC network that simulates the large (10 µF, 100 µF) capacitors and correlated to the above circuit. Line and load regulation cannot be directly tested in production. These parameters are guaranteed by measuring the bias current at pin 1 and the dc gain from pin 1 to pin 2. Limits are correlated by bench testing to establish the required correlation factor between the two test methods.

Case outline X




| Symbol | Inches | | Millimeters | | Notes |
|---|---|---|---|---|---|
| | Min | Max | Min | Max | |
| A | .165 | .185 | 4.19 | 4.70 | |
| ϕb | .016 | .019 | 0.41 | 0.48 | 6 |
| ϕb1 | .016 | .021 | 0.41 | 0.53 | 6 |
| ϕD | .335 | .375 | 8.51 | 9.40 | |
| ϕD1 | .305 | .335 | 7.75 | 8.51 | |
| ϕD2 | .110 | .160 | 2.79 | 4.06 | 7 |
| e | .230 BSC | | 5.84 BSC | | 4 |
| e1 | .115 BSC | | 2.54 BSC | | 4 |
| F | --- | .040 | --- | 1.02 | |
| k | .027 | .034 | 0.69 | 0.86 | |
| k1 | .027 | .045 | 0.69 | 1.14 | 3 |
| L | .500 | .750 | 12.70 | 19.05 | |
| L1 | --- | .050 | --- | 1.27 | |
| L2 | .250 | --- | 6.35 | --- | |
| Q | .010 | .045 | 0.25 | 1.14 | 7 |
| α | 45° BSC | | 45° BSC | | 4 |

NOTES:
1. Dimensions are in inches.
2. The US government preferred system of measurement is the metric SI system. However, this item was originally designed using inch-pound units of measurement. In the event of conflict between the metric and inch-pound units the inch-pound units shall take precedence.
3. Measured from the maximum diameter of the product.
4. Leads having a maximum diameter .019 (0.48 mm) measured .054 (1.37 mm) + .091 (2.31 mm) - .000 (0.00 mm) below the base plane of the product shall be within .007 (0.18 mm) of their true position relative to a maximum width tab.
5. The product may be measured by direct methods or by gauge.
6. All leads: Increase maximum limit by .003 inch (0.08 mm) when lead finish A is applied.
7. Optional base and seating plane.

FIGURE 1. Case outline.

| Device type | 01 |
|---|---|
| Case outlines | G, P, and X |
| Terminal number | Terminal symbol |
| 1 | FB / SD |
| 2 | CAP+ |
| 3 | GND |
| 4 | CAP- |
| 5 | $V_{OUT}$ |
| 6 | $V_{REF}$ |
| 7 | OSC |
| 8 | V+ |

FIGURE 2. Terminal connections.

3.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table I.

3.5 Marking. Marking shall be in accordance with MIL-PRF-38535, appendix A. The part shall be marked with the PIN listed in 1.2 herein. In addition, the manufacturer's PIN may also be marked as listed in MIL-HDBK-103 (see 6.6 herein). For packages where marking of the entire SMD PIN number is not feasible due to space limitations, the manufacturer has the option of not marking the "5962-" on the device.

3.6 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to be listed as an approved source of supply in MIL-HDBK-103 (see 6.6 herein). The certificate of compliance submitted to DSCC-VA prior to listing as an approved source of supply shall affirm that the manufacturer's product meets the requirements of MIL-PRF-38535, appendix A and the requirements herein.

3.7 Certificate of conformance. A certificate of conformance as required in MIL-PRF-38535, appendix A shall be provided with each lot of microcircuits delivered to this drawing.

3.8 Notification of change. Notification of change to DSCC-VA shall be required in accordance with MIL-PRF-38535, appendix A.

3.9 Verification and review. DSCC, DSCC's agent, and the acquiring activity retain the option to review the manufacturer's facility and applicable required documentation. Offshore documentation shall be made available onshore at the option of the reviewer.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-PRF-38535, appendix A.

4.2 Screening. Screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to quality conformance inspection. The following additional criteria shall apply:

a. Burn-in test, method 1015 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing or acquiring activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1015 of MIL-STD-883.

(2) $T_A$ = +125°C, minimum.

b. Interim and final electrical test parameters shall be as specified in table II herein, except interim electrical parameter tests prior to burn-in are optional at the discretion of the manufacturer.

4.3 Quality conformance inspection. Quality conformance inspection shall be in accordance with method 5005 of MIL-STD-883 including groups A, B, C, and D inspections. The following additional criteria shall apply.

4.3.1 Group A inspection.

a. Tests shall be as specified in table II herein.

b. Subgroups 7, 8, 9, 10, and 11 in table I, method 5005 of MIL-STD-883 shall be omitted.

TABLE II. Electrical test requirements.

| MIL-STD-883 test requirements | Subgroups (in accordance with MIL-STD-883, method 5005, table I) |
|---|---|
| Interim electrical parameters (method 5004) | --- |
| Final electrical test parameters (method 5004) | 1*,2,3,4 |
| Group A test requirements (method 5005) | 1,2,3,4,5,6 |
| Groups C and D end-point electrical parameters (method 5005) | 1 |

* PDA applies to subgroup 1.

4.3.2 Groups C and D inspections.

a. End-point electrical parameters shall be as specified in table II herein.

b. Steady-state life test conditions, method 1005 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing or acquiring activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1005 of MIL-STD-883.

(2) $T_A$ = +125°C, minimum.

(3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-PRF-38535, appendix A.

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use for Government microcircuit applications (original equipment), design applications, and logistics purposes.

6.2 Replaceability. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

6.3 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated with the users of record for the individual documents. This coordination will be accomplished in accordance with MIL-STD-973 using DD Form 1692, Engineering Change Proposal.

6.4 Record of users. Military and industrial users shall inform Defense Supply Center Columbus when a system application requires configuration control and the applicable SMD. DSCC will maintain a record of users and this list will be used for coordination and distribution of changes to the drawings. Users of drawings covering microelectronics devices (FSC 5962) should contact DSCC-VA, telephone (614) 692-0525.

6.5 Comments. Comments on this drawing should be directed to DSCC-VA, Columbus, Ohio 43216-5000, or telephone (614) 692-0674.

6.6 Approved sources of supply. Approved sources of supply are listed in MIL-HDBK-103. The vendors listed in MIL-HDBK-103 have agreed to this drawing and a certificate of compliance (see 3.6 herein) has been submitted to and accepted by DSCC-VA.

STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE: 99-09-30

Approved sources of supply for SMD 5962-89562 are listed below for immediate acquisition information only and shall be added to MIL-HDBK-103 and QML-38535 during the next revision. MIL-HDBK-103 and QML-38535 will be revised to include the addition or deletion of sources. The vendors listed below have agreed to this drawing and a certificate of compliance has been submitted to and accepted by DSCC-VA. This bulletin is superseded by the next dated revision of MIL-HDBK-103 and QML-38535.

| Standard microcircuit drawing PIN 1/ | Vendor CAGE number | Vendor similar PIN 2/ |
|---|---|---|
| 5962-8956201GA | 3/ | LT1054MH/883 |
| 5962-8956201PA | 64155 | LT1054MJ8/883 |
| 5962-8956201XA | 64155 | LT1054MH/883 |

1/ The lead finish shown for each PIN representing a hermetic package is the most readily available from the manufacturer listed for that part. If the desired lead finish is not listed contact the vendor to determine its availability.
2/ Caution. Do not use this number for item acquisition. Items acquired to this number may not satisfy the performance requirements of this drawing.
3/ Not available from approved source of supply.

| Vendor CAGE number | Vendor name and address |
|---|---|
| 64155 | Linear Technology Corporation<br>1630 McCarthy Boulevard<br>Milpitas, CA 95035-7487 |

The information contained herein is disseminated for convenience only and the Government assumes no liability whatsoever for any inaccuracies in the information bulletin.