REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED
A	Update drawing to the latest requirements. -sld	07-08-03	Robert M. Heber
B	Table II, add note to Group C end-point test parameters. Update boilerplate paragraphs. -gz	09-12-08	Charles F. Saffle
C	Corrected dimensions for symbols D, D2, and L1 for case outline U. Corrected dimensions for symbols D2, L, and L1 for case outline X. Corrected dimensions for symbols D, L, and L1 for case outline Y. Corrected dimensions for symbols D, D2, and L1 for case outline Z. Updated drawing paragraphs. -sld	13-01-24	Charles F. Saffle

REV																				
SHEET																				
REV																				
SHEET																				
REV STATUS				REV			C	C	C	C	C	C	C	C	C	C	C	C	C	
OF SHEETS				SHEET			1	2	3	4	5	6	7	8	9	10	11	12	13	

PMIC N/A

PREPARED BY
Steve L. Duncan

DLA LAND AND MARITIME
COLUMBUS, OHIO 43218-3990
http://www.landandmaritime.dla.mil/

STANDARD MICROCIRCUIT DRAWING

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

AMSC N/A

CHECKED BY
Greg Cecil

APPROVED BY
Raymond Monnin

DRAWING APPROVAL DATE
02-11-21

MICROCIRCUIT, HYBRID, LINEAR, 9 VOLT, SINGLE CHANNEL, DC/DC CONVERTER

REVISION LEVEL
C

SIZE	CAGE CODE	
A	**67268**	**5962-02559**

SHEET 1 OF 13

1. SCOPE

1.1 Scope. This drawing documents five product assurance classes as defined in paragraph 1.2.3 and MIL-PRF-38534. A choice of case outlines and lead finishes which are available and are reflected in the Part or Identifying Number (PIN). When available, a choice of radiation hardness assurance levels are reflected in the PIN.

1.2 PIN. The PIN shall be as shown in the following example:

5962	-	02559	01	H	U	X
Federal stock class designator	RHA designator (see 1.2.1)		Device type (see 1.2.2)	Device class designator (see 1.2.3)	Case outline (see 1.2.4)	Lead finish (see 1.2.5)
_____ Drawing number _____						

1.2.1 Radiation hardness assurance (RHA) designator. RHA marked devices shall meet the MIL-PRF-38534 specified RHA levels and shall be marked with the appropriate RHA designator. A dash (-) indicates a non-RHA device.

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

Device type	Generic number	Circuit function
01	AFL5009S/CH	DC/DC converter, 90 W, +9 V output

1.2.3 Device class designator. This device class designator shall be a single letter identifying the product assurance level. All levels are defined by the requirements of MIL-PRF-38534 and require QML Certification as well as qualification (Class H, K, and E) or QML Listing (Class G and D). The product assurance levels are as follows:

Device class	Device performance documentation
K	Highest reliability class available. This level is intended for use in space applications.
H	Standard military quality class level. This level is intended for use in applications where non-space high reliability devices are required.
G	Reduced testing version of the standard military quality class. This level uses the Class H screening and In-Process Inspections with a possible limited temperature range, manufacturer specified incoming flow, and the manufacturer guarantees (but may not test) periodic and conformance inspections (Group A, B, C, and D).
E	Designates devices which are based upon one of the other classes (K, H, or G) with exception(s) taken to the requirements of that class. These exception(s) must be specified in the device acquisition document; therefore the acquisition document should be reviewed to ensure that the exception(s) taken will not adversely affect system performance.
D	Manufacturer specified quality class. Quality level is defined by the manufacturers internal, QML certified flow. This product may have a limited temperature range.

1.2.4 Case outlines. The case outlines are as designated in MIL-STD-1835 and as follows:

Outline letter	Descriptive designator	Terminals	Package style
U	See figure 1	12	Y case configuration with leads bent upwards
X	See figure 1	12	Straight leads with end mounting through holes
Y	See figure 1	12	Straight leads with side mounting through holes
Z	See figure 1	12	Y case configuration with leads bent downwards

1.2.5 Lead finish. The lead finish shall be as specified in MIL-PRF-38534.

1.3 Absolute maximum ratings. 1/

Input voltage range	-0.5 V dc to +100 V dc
Lead temperature (soldering, 10 seconds)	+300°C
Storage temperature	-65°C to +135°C

1.4 Recommended operating conditions.

Input voltage range	+30 V dc to +80 V dc
Output power 2/	≤ 90 W
Case operating temperature range (T_C)	-55°C to +125°C

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 cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-38534 - Hybrid Microcircuits, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-883 - Test Method Standard Microcircuits.
MIL-STD-1835 - Interface Standard Electronic Component Case Outlines.

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-103 - List of Standard Microcircuit Drawings.
MIL-HDBK-780 - Standard Microcircuit Drawings.

(Copies of these documents are available online at https://assist.dla.mil/quicksearch/ or 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 performance requirements for device classes D, E, G, H, and K shall be in accordance with MIL-PRF-38534. Compliance with MIL-PRF-38534 shall include the performance of all tests herein or as designated in the device manufacturer's Quality Management (QM) plan or as designated for the applicable device class. The manufacturer may eliminate, modify or optimize the tests and inspections herein, however the performance requirements as defined in MIL-PRF-38534 shall be met for the applicable device class. In addition, the modification in the QM plan shall not affect the form, fit, or function of the device for the applicable device class.

1/ Stresses above the absolute maximum ratings may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability.
2/ Derate output power linearly above case temperature +125°C to 0 at +135°C.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38534 and herein.

3.2.1 Case outlines. The case outlines shall be in accordance with 1.2.4 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 specified operating temperature range.

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

3.5 Marking of devices. Marking of devices shall be in accordance with MIL-PRF-38534. The device shall be marked with the PIN listed in 1.2 herein. In addition, the manufacturer's vendor similar PIN may also be marked.

3.6 Data. In addition to the general performance requirements of MIL-PRF-38534, the manufacturer of the device described herein shall maintain the electrical test data (variables format) from the initial quality conformance inspection group A lot sample, for each device type listed herein. Also, the data should include a summary of all parameters manually tested, and for those which, if any, are guaranteed. This data shall be maintained under document revision level control by the manufacturer and be made available to the preparing activity (DLA Land and Maritime -VA) upon request.

3.7 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to supply to this drawing. The certificate of compliance (original copy) submitted to DLA Land and Maritime -VA shall affirm that the manufacturer's product meets the performance requirements of MIL-PRF-38534 and herein.

3.8 Certificate of conformance. A certificate of conformance as required in MIL-PRF-38534 shall be provided with each lot of microcircuits delivered to this drawing.

4. VERIFICATION

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-PRF-38534 or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein.

4.2 Screening. Screening shall be in accordance with MIL-PRF-38534. 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 either DLA Land and Maritime -VA or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1015 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1015 of MIL-STD-883.

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.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ $-55°C \le T_C \le +125°C$ V_{IN} = 50 V dc ±5%, C_L = 0 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 10 A	1	01	+8.91	+9.09	V
			2,3		+8.82	+9.18	
Output current 2/	I_{OUT}	V_{IN} = 30, 50, and 80 V dc	1,2,3	01		10	A
Output ripple voltage	V_{RIP}	V_{IN} = 30, 50, and 80 V dc, B.W. = 10 MHz	1,2,3	01		40	mV p-p
Line regulation	VR_{LINE}	V_{IN} = 30, 50, and 80 V dc, I_{OUT} = 0, 5, and 10 A	1,2,3	01	-20	+20	mV
Load regulation	VR_{LOAD}	V_{IN} = 30, 50, and 80 V dc, I_{OUT} = 0, 5, and 10 A	1,2,3	01	-90	+90	mV
Input current	I_{IN}	I_{OUT} = no load	1	01		50	mA
			2,3			60	
		Enable 1, (pin 4) shorted to Input return (pin 2)	1,2,3			5	
		Enable 2, (pin 12) shorted to Output return (pin 8)	1,2,3			5	
Input ripple current	I_{RIP}	I_{OUT} = 10 A, B.W. = 10 MHz	1,2,3	01		60	mA p-p
Efficiency	E_{FF}	I_{OUT} = 10 A	1,2,3	01	80		%
Isolation	ISO	Input to output or any pin to case (except pin 3) at 500 V dc, T_C = +25°C	1	01	100		MΩ
Maximum capacitive load 3/	C_L	No effect on dc performance, T_C = +25°C	4	01	10,000		µF
Power dissipation load fault	P_D	Overload	1,2,3	01		32	W
		Short circuit				32	

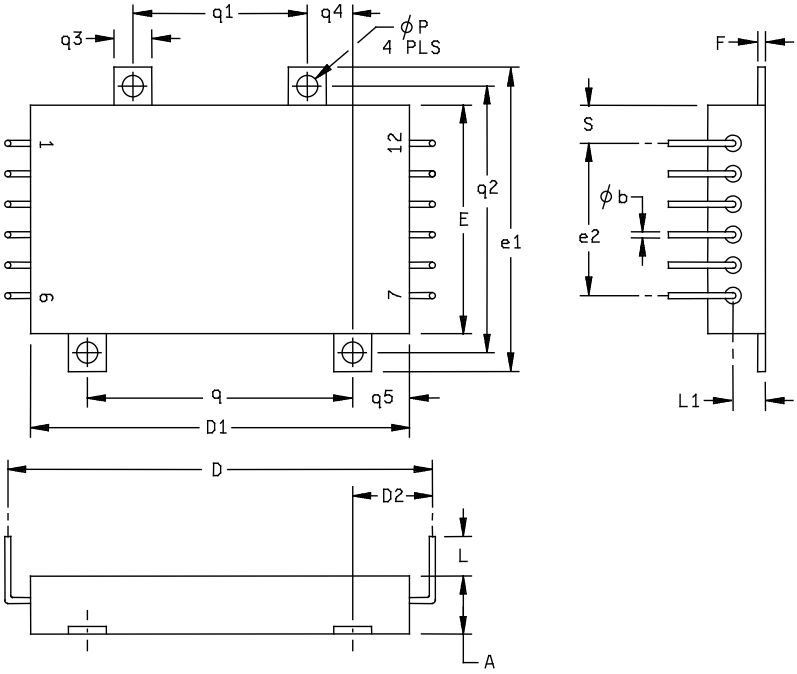
See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55°C \le T_C \le +125°C$ V_{IN} = 50 V dc ±5%, C_L = 0 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Current limit point 4/	I_{CL}	V_{OUT} = 90% V_{NOM}	1	01	11.50	12.50	A
			2		10.50	11.50	
			3		12.50	14.00	
Switching frequency	F_S	I_{OUT} = 10 A	1,2,3	01	500	600	kHz
Sync frequency range	F_{SYNC}	I_{OUT} = 10 A	1,2,3	01	500	700	kHz
Output response to step transient load changes 5/ 6/	VO_{TLOAD}	50% to/from 100%	4,5,6	01	-600	+600	mV pk
		10% to/from 50%			-600	+600	
Recovery time, step transient load changes 5/ 6/	TT_{LOAD}	50% to/from 100%	4,5,6	01		200	µs
		10% to/from 50%				400	
Output response to transient step line changes 3/ 5/ 7/	VO_{TLINE}	Input step, 30 V to/from 80 V dc, I_{OUT} = 10 A	4,5,6	01	-500	+500	mV pk
Recovery time transient step line changes 3/ 5/ 7/	TT_{LINE}	Input step, 30 V to/from 80 V dc, I_{OUT} = 10 A	4,5,6	01		500	µs
Turn on overshoot 8/	$VTon_{OS}$	I_{OUT} = 0 and 10 A	4,5,6	01		250	mV pk
Turn on delay 8/	Ton_D	I_{OUT} = 0 and 10 A	4,5,6	01		120	ms
Load fault recovery 8/	Tr_{LF}		4,5,6	01		120	ms

1/ All electrical tests are performed with the remote sense pins connected to the output pins at the load.
2/ Parameter verified as part of another test.
3/ Parameter not 100% tested but are guaranteed to the limits specified in table I.
4/ Current limit point is that condition of excess load causing output voltage to drop to 90% of nominal.
5/ Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1% of V_{OUT} at 50% load.
6/ Load transient transition time ≥ 10 µs.
7/ Line transient transition time ≥ 100 µs.
8/ Turn-on delay is measured with an input voltage rise time of between 100 and 500 volts per millisecond.

Case outline U.

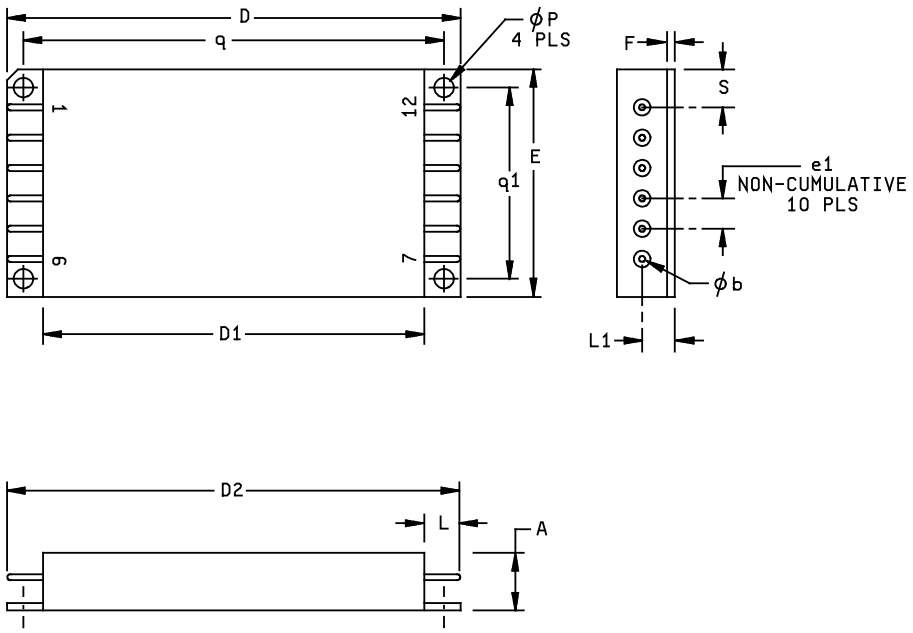


	Millimeters		Inches	
Symbol	Min	Max	Min	Max
A		9.65		.380
D	70.35	71.96	2.770	2.833
D1	63.37	63.63	2.495	2.505
D2	13.08	13.59	.515	.535
E	37.97	38.23	1.495	1.505
e1	50.6	51.1	1.99	2.01
e2	25.27	25.53	.995	1.005
F	1.14	1.40	.045	.055
L	10.4	10.9	.41	.43
L1	5.33	5.84	.210	.230
q	44.32	44.58	1.745	1.755
q1	29.08	29.34	1.145	1.155
q2	44.32	44.58	1.745	1.755
q3	6.1	6.6	.24	.26
q4	7.49	7.75	.295	.305
q5	9.40	9.65	.370	.380
S	6.22	6.48	.245	.255
∅b	0.89	1.14	.035	.045
∅p	3.43	3.68	.135	.145

NOTES:
1. The U.S. government preferred system of measurement is the metric SI. This item was designed using inch-pound units of measurement. In case of problems involving conflicts between the metric and inch-pound units, the inch-pound units shall rule.
2. Lead identification for reference only.
3. Case outline weight: 92 grams maximum.

FIGURE 1. Case outlines.

Case outline X.

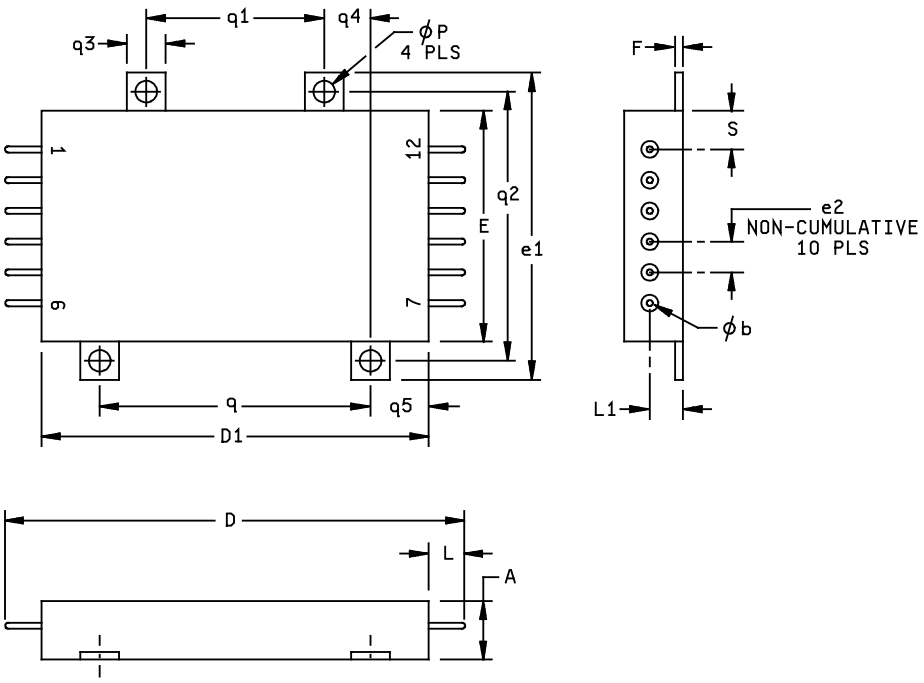


	Millimeters		Inches	
Symbol	Min	Max	Min	Max
A		9.65		.380
D	76.07	76.33	2.995	3.005
D1	63.37	63.63	2.495	2.505
D2		76.23		3.001
E	37.97	38.23	1.495	1.505
e1	4.95	5.21	.195	.205
F	1.14	1.40	.045	.055
L		6.30		.248
L1	5.34	5.84	.210	.230
q	69.98	70.23	2.755	2.765
q1	31.88	32.13	1.255	1.265
S	6.22	6.48	.245	.255
∅b	0.89	1.14	.035	.045
∅p	3.12	3.38	.123	.133

NOTES:
1. The U.S. government preferred system of measurement is the metric SI. This item was designed using inch-pound units of measurement. In case of problems involving conflicts between the metric and inch-pound units, the inch-pound units shall rule.
2. Lead identification for reference only.
3. Case outline weight: 92 grams maximum.

FIGURE 1. Case outlines - Continued.

Case outline Y.

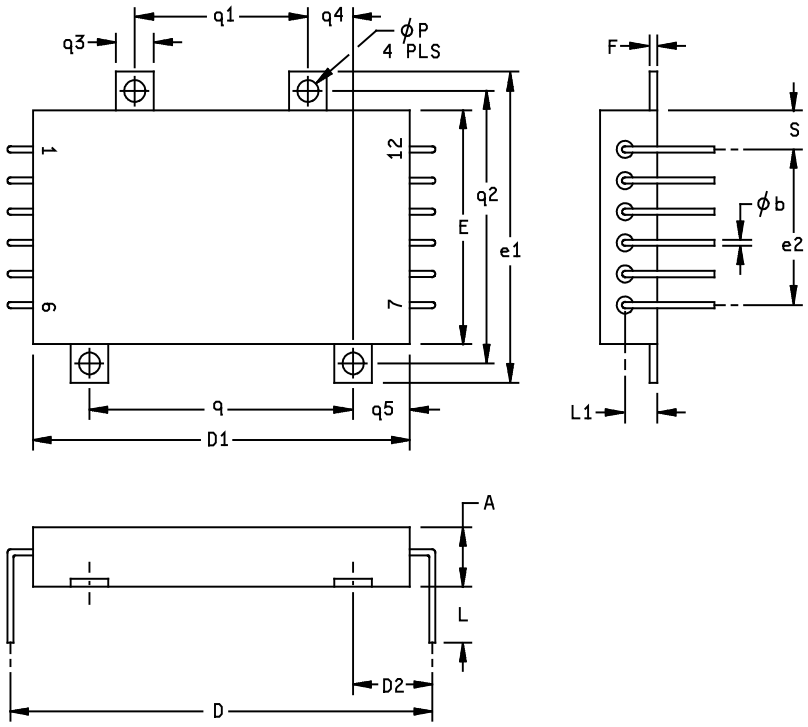


	Millimeters		Inches	
Symbol	Min	Max	Min	Max
A		9.65		.380
D		76.23		3.001
D1	63.37	63.63	2.495	2.505
E	37.97	38.23	1.495	1.505
e1	50.6	51.1	1.99	2.01
e2	4.95	5.21	.195	.205
F	1.14	1.40	.045	.055
L		6.30		.248
L1	5.34	5.84	.210	.230
q	44.32	44.58	1.745	1.755
q1	29.08	29.34	1.145	1.155
q2	44.32	44.58	1.745	1.755
q3	6.1	6.6	.24	.26
q4	7.49	7.75	.295	.305
q5	9.40	9.65	.370	.380
S	6.22	6.48	.245	.255
∅b	0.89	1.14	.035	.045
∅p	3.43	3.68	.135	.145

NOTES:
1. The U.S. government preferred system of measurement is the metric SI. This item was designed using inch-pound units of measurement. In case of problems involving conflicts between the metric and inch-pound units, the inch-pound units shall rule.
2. Lead identification for reference only.
3. Case outline weight: 92 grams maximum.

FIGURE 1. Case outlines - Continued.

Case outline Z.



	Millimeters		Inches	
Symbol	Min	Max	Min	Max
A		9.65		.380
D	70.35	71.96	2.770	2.833
D1	63.37	63.63	2.495	2.505
D2	13.08	13.59	.515	.535
E	37.97	38.23	1.495	1.505
e1	50.6	51.1	1.99	2.01
e2	25.27	25.53	.995	1.005
F	1.14	1.40	.045	.055
L	8.9	9.4	.35	.37
L1	5.33	5.84	.210	.230
q	44.32	44.58	1.745	1.755
q1	29.08	29.34	1.145	1.155
q2	44.32	44.58	1.745	1.755
q3	6.1	6.6	.24	.26
q4	7.49	7.75	.295	.305
q5	9.40	9.65	.370	.380
S	6.22	6.48	.245	.255
∅b	0.89	1.14	.035	.045
∅p	3.43	3.68	.135	.145

NOTES:
1. The U.S. government preferred system of measurement is the metric SI. This item was designed using inch-pound units of measurement. In case of problems involving conflicts between the metric and inch-pound units, the inch-pound units shall rule.
2. Lead identification for reference only.
3. Case outline weight: 92 grams maximum.

FIGURE 1. Case outlines - Continued.

Device type	01
Case outlines	U, X, Y, and Z
Terminal number	Terminal symbol
1	Positive input
2	Input return
3	Case
4	Enable 1
5	Sync output
6	Sync input
7	Positive output
8	Output return
9	Return sense
10	Positive sense
11	Share
12	Enable 2

FIGURE 2. Terminal connections.

TABLE II. Electrical test requirements.

MIL-PRF-38534 test requirements	Subgroups (in accordance with MIL-PRF-38534, group A test table)
Interim electrical parameters	---
Final electrical parameters	1*, 2, 3, 4, 5, 6
Group A test requirements	1, 2, 3, 4, 5, 6
Group C end-point electrical parameters 1/	1, 2, 3, 4
End-point electrical parameters for radiation hardness assurance (RHA) devices	Not applicable

* PDA applies to subgroup 1.
1/ As a minimum, for all Group C testing performed after December 8, 2009 manufacturers shall perform subgroups 1, 2, and 3 from the Group A electrical test table (Table C-Xa of MIL-PRF-38534).

4.3 Conformance and periodic inspections. Conformance inspection (CI) and periodic inspection (PI) shall be in accordance with MIL-PRF-38534 and as specified herein.

4.3.1 Group A inspection (CI). Group A inspection shall be in accordance with MIL-PRF-38534 and as follows:

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

b. Subgroups 7, 8, 9, 10, and 11 shall be omitted.

4.3.2 Group B inspection (PI). Group B inspection shall be in accordance with MIL-PRF-38534.

4.3.3 Group C inspection (PI). Group C inspection shall be in accordance with MIL-PRF-38534 and as follows:

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

b. Steady-state life test, 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 either DLA Land and Maritime -VA or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1005 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1005 of MIL-STD-883.

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

4.3.4 Group D inspection (PI). Group D inspection shall be in accordance with MIL-PRF-38534.

4.3.5 Radiation Hardness Assurance (RHA) inspection. RHA inspection is not currently applicable to this drawing.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-PRF-38534.

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 as specified in MIL-PRF-38534.

6.4 Record of users. Military and industrial users shall inform DLA Land and Maritime when a system application requires configuration control and the applicable SMD to that system. DLA Land and Maritime 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 microelectronic devices (FSC 5962) should contact DLA Land and Maritime-VA, telephone (614) 692-8108.

6.5 Comments. Comments on this drawing should be directed to DLA Land and Maritime-VA, Columbus, Ohio 43218-3990, or telephone (614) 692-1081.

6.6 Sources of supply. Sources of supply are listed in MIL-HDBK-103 and QML-38534. The vendors, listed in MIL-HDBK-103 and QML-38534, have submitted a certificate of compliance (see 3.7 herein) to DLA Land and Maritime-VA and have agreed to this drawing.

STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE: 13-01-24

Approved sources of supply for SMD 5962-02559 are listed below for immediate acquisition information only and shall be added to MIL-HDBK-103 and QML-38534 during the next revisions. MIL-HDBK-103 and QML-38534 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 DLA Land and Maritime -VA. This information bulletin is superseded by the next dated revisions of MIL-HDBK-103 and QML-38534. DLA Land and Maritime maintains an online database of all current sources of supply at http://www.landandmaritime.dla.mil/Programs/Smcr/.

Standard microcircuit drawing PIN 1/	Vendor CAGE number	Vendor similar PIN 2/
5962-0255901HUA	52467	AFL5009SW/CH
5962-0255901HUC	52467	AFL5009SW/CH
5962-0255901HXA	52467	AFL5009SX/CH
5962-0255901HXC	52467	AFL5009SX/CH
5962-0255901HYA	52467	AFL5009SY/CH
5962-0255901HYC	52467	AFL5009SY/CH
5962-0255901HZA	52467	AFL5009SZ/CH
5962-0255901HZC	52467	AFL5009SZ/CH

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.

Vendor CAGE number	Vendor name and address
52467	International Rectifier Corporation 2520 Junction Ave. San Jose, CA 95134

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