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LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

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OF SHEETS	SHEET	1	2	3	4	5	6	7	8	9	10	11			

PMIC N/A

PREPARED BY
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DRAWING APPROVAL DATE
10-03-23

REVISION LEVEL

DEFENSE SUPPLY CENTER COLUMBUS
COLUMBUS, OHIO 43218-3990
http://www.dscc.dla.mil

STANDARD MICROCIRCUIT DRAWING

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

AMSC N/A

MICROCIRCUIT, HYBRID, 15 VOLT, DUAL CHANNEL, DC/DC CONVERTER

SIZE	CAGE CODE	
A	**67268**	**5962-10216**

SHEET 1 OF 11

DSCC FORM 2233
APR 97

5962-E188-10

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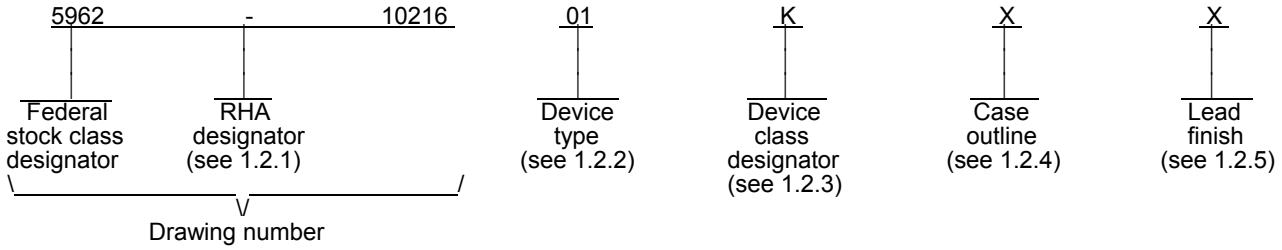
1. SCOPE

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:



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	M3G2815D/CK	DC/DC converter, 40 W, ±15 V Outputs

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

Outline letter	Descriptive designator	Terminals	Package style
X	See figure 1	13	Straight leads with side mounting tabs

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

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1.3 Absolute maximum ratings. 1/

Input voltage range	-0.5 V dc to +80 V dc
Lead temperature (soldering, 10 seconds)	+300°C
Storage temperature	-55°C to +135°C

1.4 Recommended operating conditions.

Input voltage range	+18 V dc to +50 V dc
Output power 2/ 3/	≤ 40 W
Case operating temperature range (T_C) 4/	-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 SPECIFICATION

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

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-883 - Test Method Standard Microcircuits.
MIL-STD-1835 - Interface Standard for 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.daps.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 may 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. Therefore, the tests and inspections herein may not be performed for the applicable device class (see MIL-PRF-38534). 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/ Limit represent 80 percent of total rated output current. To achieve rated output power, the remaining 20 percent of the total rated output current must be provided by the other output.
4/ For operation at temperatures between +85°C and +125°C, derate the maximum input voltage linearly from 60 V dc to 40 V dc and the maximum output power linearly from 100 percent to 75 percent.

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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 outline(s). The case outline(s) 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 device(s). Marking of device(s) 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 (DSCC-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 DSCC-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 DSCC-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.

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TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ $-55°C \le T_C \le +85°C$ V_{IN} = 28 V dc ±5%, C_L = 0 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Output voltage 2/	V_{OUT}	I_{OUT} = 1.333 A	1	01	+14.94	+15.06	V
			2,3		+14.80	+15.20	
Output current 3/	I_{OUT}	V_{IN} = 18, 28, 50 V dc Either output	1,2,3	01		2.14	A
Output ripple voltage 2/ 4/	V_{RIP}	V_{IN} = 1.333 A Both outputs.	1,2,3	01		60	mV p-p
Line regulation 2/	VR_{LINE}	V_{IN} = 18, 28, 40 V dc, I_{OUT} = 0, 50%, 100% rated load both outputs.	1,2,3	01	-10	+10	mV
Load regulation 2/	VR_{LOAD}	V_{IN} = 18, 28, and 50 V dc, I_{OUT} = 0, 50%, and 100% rated load both outputs.	1,2,3	01	-0.5	+0.5	%
Cross regulation 5/	VR_{CROSS}	V_{IN} = 18, 28, and 50 V dc, I_{OUT} = 0, 50%, 100% rated load both outputs.	1,2,3	01	-3.0	+3.0	%
Input current	I_{IN}	I_{OUT} = 0, pin 3 open	1,2,3	01		100	mA
		Pin 3 shorted to Input return Pin 2	1,2,3	01		5.0	mA
Efficiency 2/	E_{FF}	I_{OUT} = 1.333 A	1,2,3	01	77		%
Isolation	ISO	Input to output or any pin to case (except pin 6) at 500 V dc	1	01	100		MΩ
Maximum capacitive load 2/ 6/ 7/	C_L	I_{OUT} = 1.333 A No effect on dc performance, Each outputs of duals	1	01		60	µF
Power dissipation load fault 8/	PD	Short circuit	1,2,3	01		20	W
		Overload	1,2,3	01		20	
Current limit point 8/	I_{CL}	V_{OUT} = 90% of Nominal	1,2	01	105	135	%
			3	01	105	150	
Switching frequency	F_S	Sync input (pin 4) open I_{OUT} = 1.333 A	1,2,3	01	450	550	kHz
Sync frequency range, 6/	F_{SYNC}	External clock on Sync input pin 4. I_{OUT} = 1.333 A	1,2,3	01	450	600	kHz
Output response to step load changes 2/ 7/	VT_{LOAD}	50% to/from 100% load	4,5,6	01	-300	+300	mV pk

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55°C \le T_C \le +85°C$ V_{IN} = 28 V dc ±5%, C_L = 0 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Recovery time, step load changes 2/ 9/ 10/	TT_{LOAD}	50% to/from 100% load	4,5,6	01		200	µs
Output response to step line changes 2/ 6/ 11/	VT_{LINE}	Input step, 18 V to/from 50 V I_{OUT} = 1.333 A	4,5,6	01	-300	+300	mV pk
Recovery time step transient line changes 2/ 6/ 10/ 11/	TT_{LINE}	Input step, 18 V to/from 40 V I_{OUT} = 1.333 A	4,5,6	01		200	µs
Turn on overshoot 2/ 12/	$VTon_{OS}$	0% load, 100% load Enable on.	4,5,6	01		10	%
Turn on delay 12/	Ton_D	0% load, 100% load. Enable on.	4,5,6	01	1.0	5.0	ms

1/ For operation at temperatures between +85°C and +125°C derate the maximum input voltage linearly from 60 V_{DC} to 40 V_{DC} and the maximum output power linearly from 100 percent to 75 percent.
2/ Load current is split equally between outputs.
3/ Limit represents 80 percent of total rated output current. To achieve rated output power, the remaining 20 percent of the total rated output current must be provided by the other output.
4/ Guaranteed for a DC to 20 MHz bandwidth. Tested using a 20 KHz to 10 MHz bandwidth.
5/ Cross regulation is measured with 20 percent rated load on output under test while changing the load on the other output from 20 percent to 80 percent of rated.
6/ Parameter is tested as part of design characterization or after design changes. Thereafter, parameter shall be guaranteed to the limits specified.
7/ Capacitive load may be any value from 0 to the maximum limit without compromising dc performance. A capacitive load in excess of the maximum limit may interfere with the proper operation of the converter's overload protection, causing erratic behavior during turn-on.
8/ Overload power dissipation is defined as the device power dissipation with the load set such that V_{OUT} = 90 percent of nominal.
9/ Load step transition time ≥ 10 µs.
10/ Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1% of its steady state value
11/ Line step transition time ≥ 10 µs.
12/ Turn-on delay time is measured from either a step application of input power or a logic low to a logic high transition on the inhibit pin (pin 3) to the point where V_{OUT} = 90 percent of nominal.

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Case outline X.

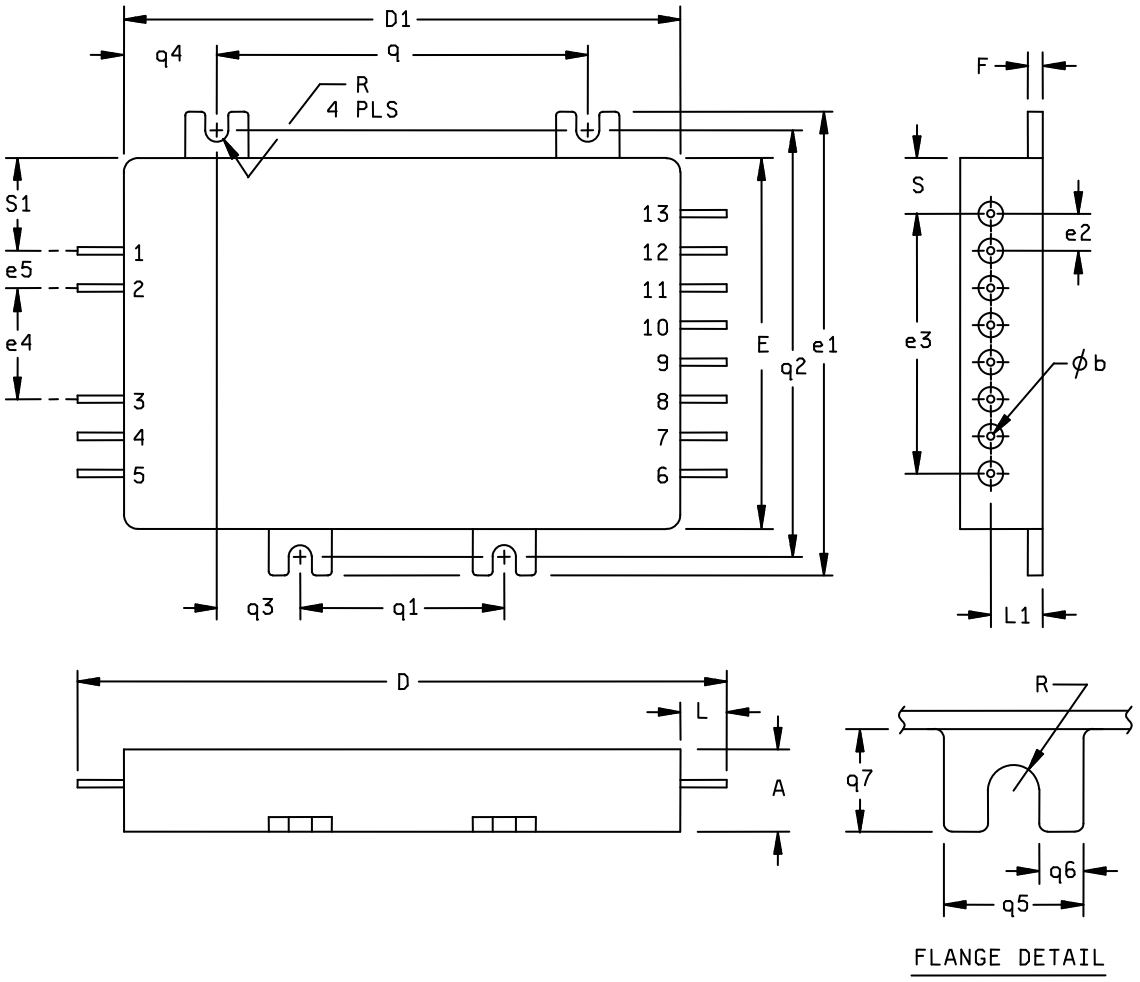

FIGURE 1. Case outline.

STANDARD MICROCIRCUIT DRAWING	SIZE A		5962-10216
DEFENSE SUPPLY CENTER COLUMBUS COLUMBUS, OHIO 43218-3990		REVISION LEVEL	SHEET 7

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Symbol	Millimeters		Inches	
	Min	Max	Min	Max
A		11.30		.445
D	88.90 REF		3.50 REF	
D1		77.85		3.065
E		52.20		2.055
e1	63.37	63.63	2.495	2.505
e2/e5	4.95	5.21	.195	.205
e3	35.56 REF		1.400 REF	
e4	15.11	15.37	.595	.605
F		2.03		.080
L/q7	6.10	6.60	.240	.260
L1	6.48	6.73	.255	.265
q	50.55	55.05	1.990	2.010
q1	27.69	28.19	1.090	1.110
q2	58.17	58.67	2.290	2.310
q3	11.18	11.67	.440	.460
q4	12.57	12.83	.495	.505
q5	9.91	10.41	.390	.410
q6	3.30	3.81	.130	.150
R		1.588		.625
S	7.37	7.87	.290	.310
S1	12.45	12.95	.490	.510
∅b	.89	1.14	.035	.045

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: 110 grams maximum.

FIGURE 1. Case outline - Continued.

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Device type	01
Case outline	X
Terminal number	Terminal symbol
1	+ Input Voltage
2	Input return
3	Inhibit
4	Sync input
5	Sync output
6	Case Ground
7	No connection
8	Output Adjust
9	No connection
10	No connection
11	- Output Voltage
12	Output Return
13	+ Output Voltage

FIGURE 2. Terminal connections.

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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, 2, 3, 4
End-point electrical parameters for radiation hardness assurance (RHA) devices	Not applicable

* PDA applies to subgroup 1.

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 DSCC-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.

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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 Defense Supply Center Columbus (DSCC) 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 microelectronic devices (FSC 5962) should contact DSCC-VA, telephone (614) 692-0544.

6.5 Comments. Comments on this drawing should be directed to DSCC-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 DSCC-VA and have agreed to this drawing.

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STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE: 10-03-23

Approved sources of supply for SMD 5962-10216 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 DSCC-VA. This information bulletin is superseded by the next dated revisions of MIL-HDBK-103 and QML-38534. DSCC maintains an online database of all current sources of supply at http://www.dscc.dla.mil/Programs/Smcr/.

Standard microcircuit drawing PIN 1/	Vendor CAGE number	Vendor similar PIN 2/
5962-1021601KXA 5962-1021601KXC	52467 52467	M3G2815D/CK M3G2815D/CK

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 – Hi Rel Products, Incorporated 2520 Junction Ave San Jose, CA 95134

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