

LT3045EDD-1 20V, 2A, Paralleled Ultralow Noise, Ultrahigh PSRR LDO Regulator

DESCRIPTION

Demo circuit 2637A features four **LT®3045EDD-1s** in parallel, generating an ultralow noise, ultrahigh power supply rejection ratio (PSRR) low dropout (LDO) regulator with programmable current limit. DC2637A operates over an input range of 3.8V to 20V, and is capable of delivering up to 2A output current by paralleling four LT3045EDD-1s with only 20mΩ ballast resistors.

The VIOC tracking function of the LT3045EDD-1 controls an upstream switching converter to maintain a constant voltage across the regulator and hence minimize power dissipation. In the parallel configuration, connect the VIOC pin of only one IC to the switching converter, while the VIOC pins of the other ICs are left floating. The power good feedback (PGFB) pin is used to set a programmable power good threshold, and also activates the fast start-up circuitry. The PGFB is set on only one IC when they are paralleled. LT3045-1 also offers programmable current limit functionality by connecting a resistor from ILIM to

GND on each device. Current monitoring is also achieved by sensing the ILIM pin voltage.

Built-in protection includes reverse battery protection, reverse current protection, internal current limit with fold-back, and thermal limit with hysteresis.

The LT3045-1 data sheet gives a complete description of the device, operation and applications information. The data sheet must be read in conjunction with this demo manual for demonstration circuit 2637A. The LT3045EDD-1 is assembled in a 12-lead (3mm × 3mm) plastic DFN package with an exposed pad on the bottom-side of the IC. Proper board layout is essential for maximum thermal performance.

Design files for this circuit board are available at <http://www.analog.com/DC2637A>

All registered trademarks and trademarks are the property of their respective owners.

PERFORMANCE SUMMARY Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range (V _{IN})	I _{OUT} = 500mA, V _{OUT} = 3.3V	3.8		20	VDC
	I _{OUT} = 2A, V _{OUT} = 3.3V	3.8		5.5*	VDC
Output Voltage (V _{OUT})	V _{IN} = 5V, I _{OUT} = 2A	3.19	3.29	3.39	VDC
Shutdown Input Current (I _{IN})	JP1 = OFF, V _{IN} = 5V			1	μA

*The maximum input voltage for 2A load current is set by the 65°C temperature rise of LT3045-1 on the demo circuit. Higher input voltage can be reached if larger copper area or force-air cooling is applied. The output current is also limited by the differential of input and output voltage, please refer the data sheet for details.

QUICK START PROCEDURE

Demonstration circuit 2637A is easy to set up to evaluate the performance of four LT3045EDD-1s in parallel. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Connect the load between the VOUT and GND terminals.
2. With the power off, connect the input power supply to the VIN and GND terminals.
3. Make sure the shunt of JP1 is at ON option.

4. Apply 3.8V across V_{IN} to GND. Draw 2A of load current. The output voltage should be $3.29V \pm 3\%$ (3.19V to 3.39V).

5. Vary V_{IN} from 3.8V to 20V and the load current up to 2A.

NOTE: Make sure the power dissipation is below the thermal limit.

6. Refer to Application Notes AN70 and AN159 for measuring output noise and PSRR.

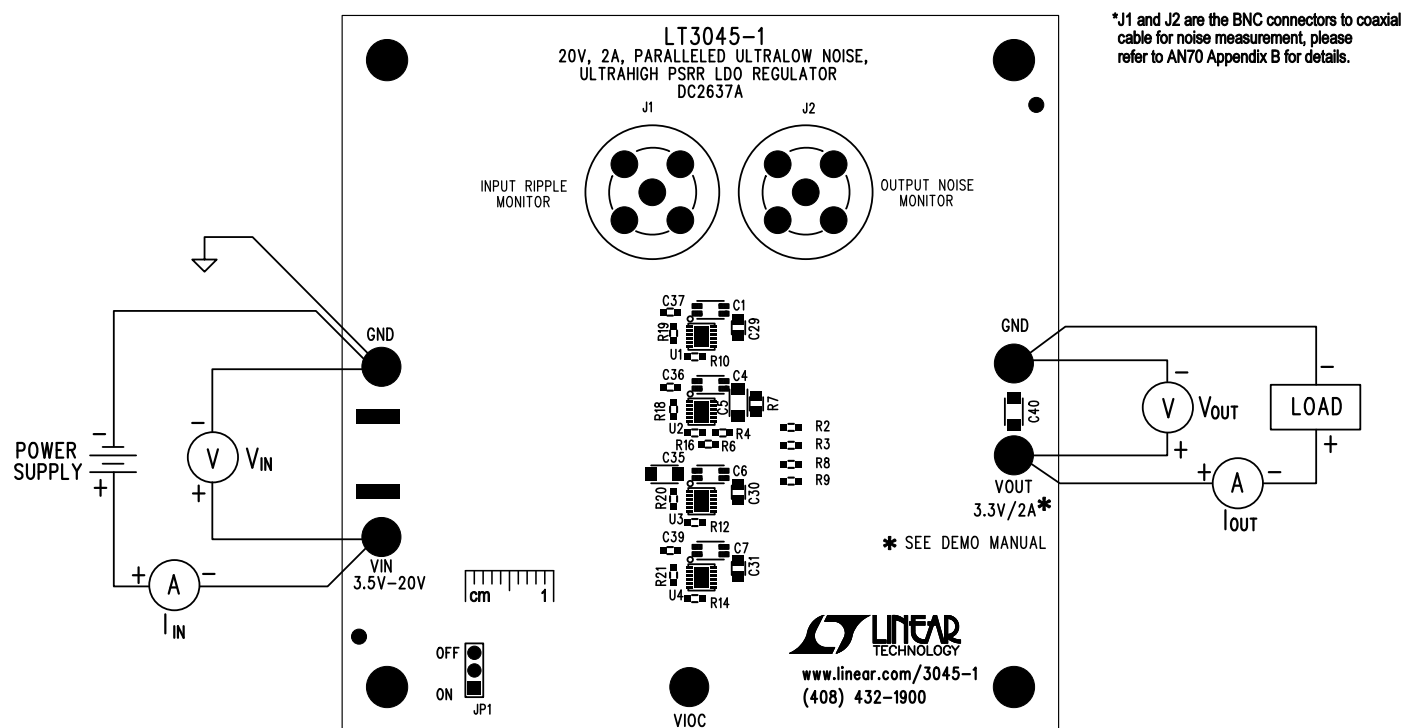


Figure 1. Test Procedure Setup Drawing for DC2637A

PCB LAYOUT

1. Best PSRR Performance: PCB Layout for Input Trace

For applications utilizing the LT3045-1 for post-regulating switching converters, placing a capacitor directly at the LT3045-1 input results in AC current (at the switching frequency) flowing near the LT3045-1. Without careful attention to PCB layout, this relatively high frequency switching current generates an electromagnetic field (EMF) that couples to the LT3045-1 output, thereby degrading its effective PSRR. While highly dependent on the PCB, the switching pre-regulator, and the input capacitor size, among other factors, the PSRR degradation can easily be 30dB at 1MHz. This degradation is present even if the LT3045-1 is de-soldered from the board, because it effectively degrades the PSRR of the PC board itself. While negligible for conventional low PSRR LDOs, LT3045-1's ultrahigh PSRR requires careful attention to higher order parasitics in order to realize the full performance offered by the regulator.

The LT3045-1 demo board alleviates this degradation in PSRR by using a specialized layout technique. In Figure 2, the input trace (VIN) is highlighted in red, and in Figure 3 the return path (GND) is also highlighted together with input capacitor C3. Normally when an AC voltage is applied to the input of the board, AC current flows on this path, thus generating EMF. This EMF couples to output capacitors (C1, C4, C6, C7) and related traces, making the PSRR appear worse than it actually is. *With the input trace directly above the return path, the EMFs are in opposite directions, and consequently cancel each other out. Making sure these traces exactly overlap each other maximizes the cancellation effect and thus provides the maximum PSRR offered by the regulator.*

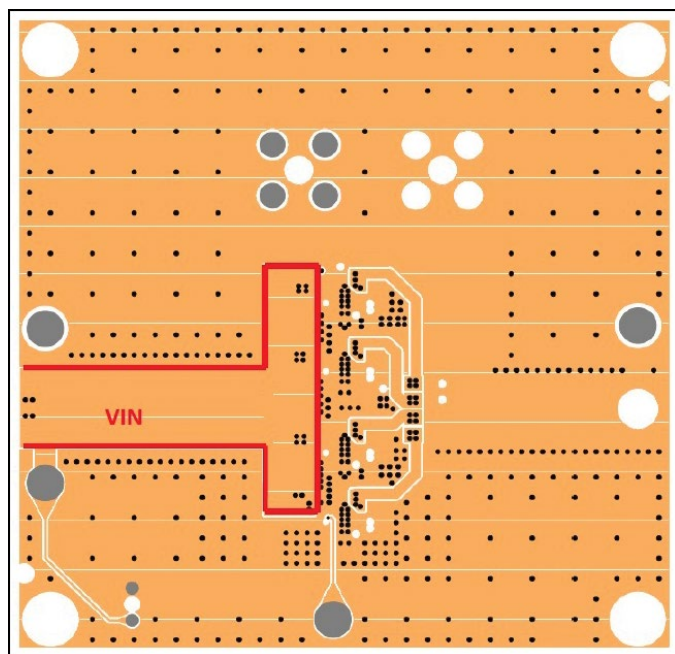


Figure 2. Layer 3 of DC2637A

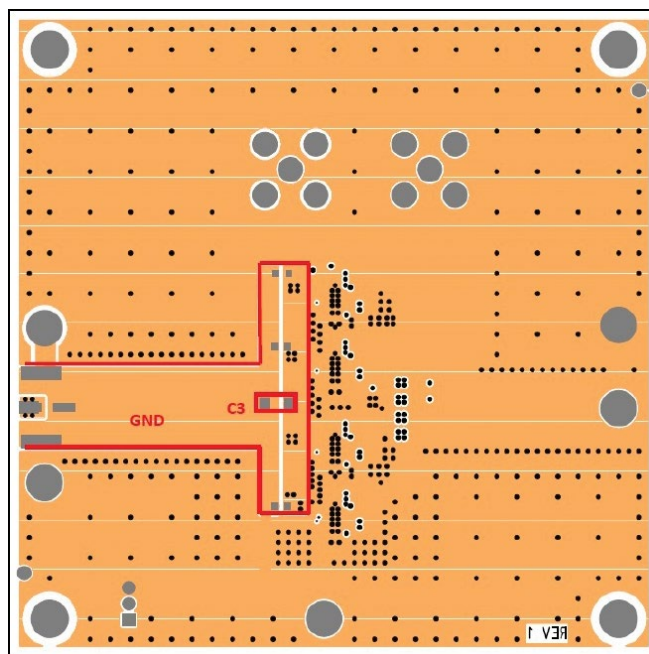


Figure 3. Bottom Layer of DC2637A

PCB LAYOUT

2. Best AC Performance: PCB Layout for Output Capacitors C1, C4, C6 and C7

For ultrahigh PSRR performance, the LT3045-1 bandwidth is quite high (~1MHz), making it very close to the output capacitor's self-resonance frequency (~1.6MHz). Therefore, it is very important to avoid adding extra impedance (ESL and ESR) outside the feedback loop. To that end, minimize the effects of PCB trace and solder inductance by Kelvin connecting OUTS and SET pin capacitor (C_{SET}) GND directly to output capacitors (C2) terminals using split capacitor techniques. In parallel configuration, for each output cap, pad 4 connects to the OUTS pin and pad 1 connects to the GND side of the SET pin capacitor. With only small current flowing through these connections, the impact of solder joint/PCB trace inductance on stability is eliminated. While the LT3045-1 is robust enough not

to oscillate if the recommended layout is not followed, phase/gain margin and stability will degrade.

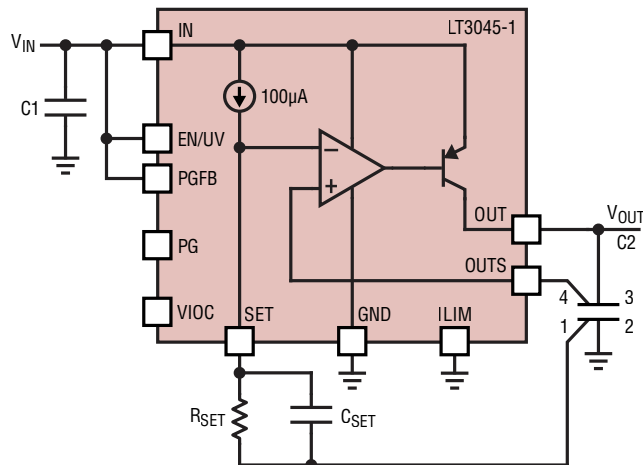


Figure 4. C2 and C_{SET} Connections for Best Performance

PCB LAYOUT

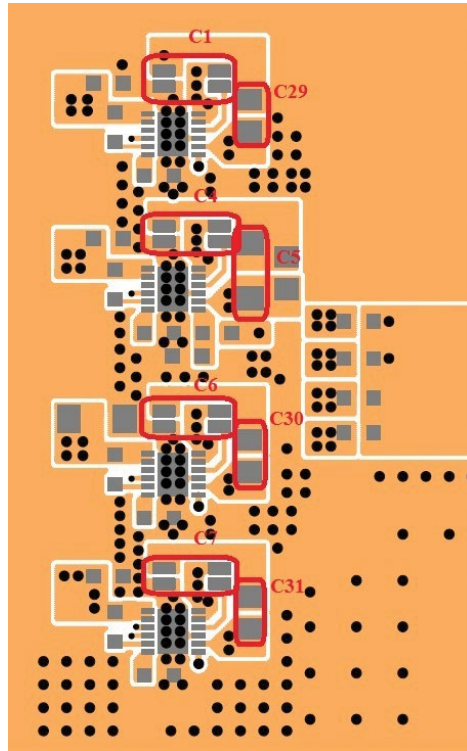


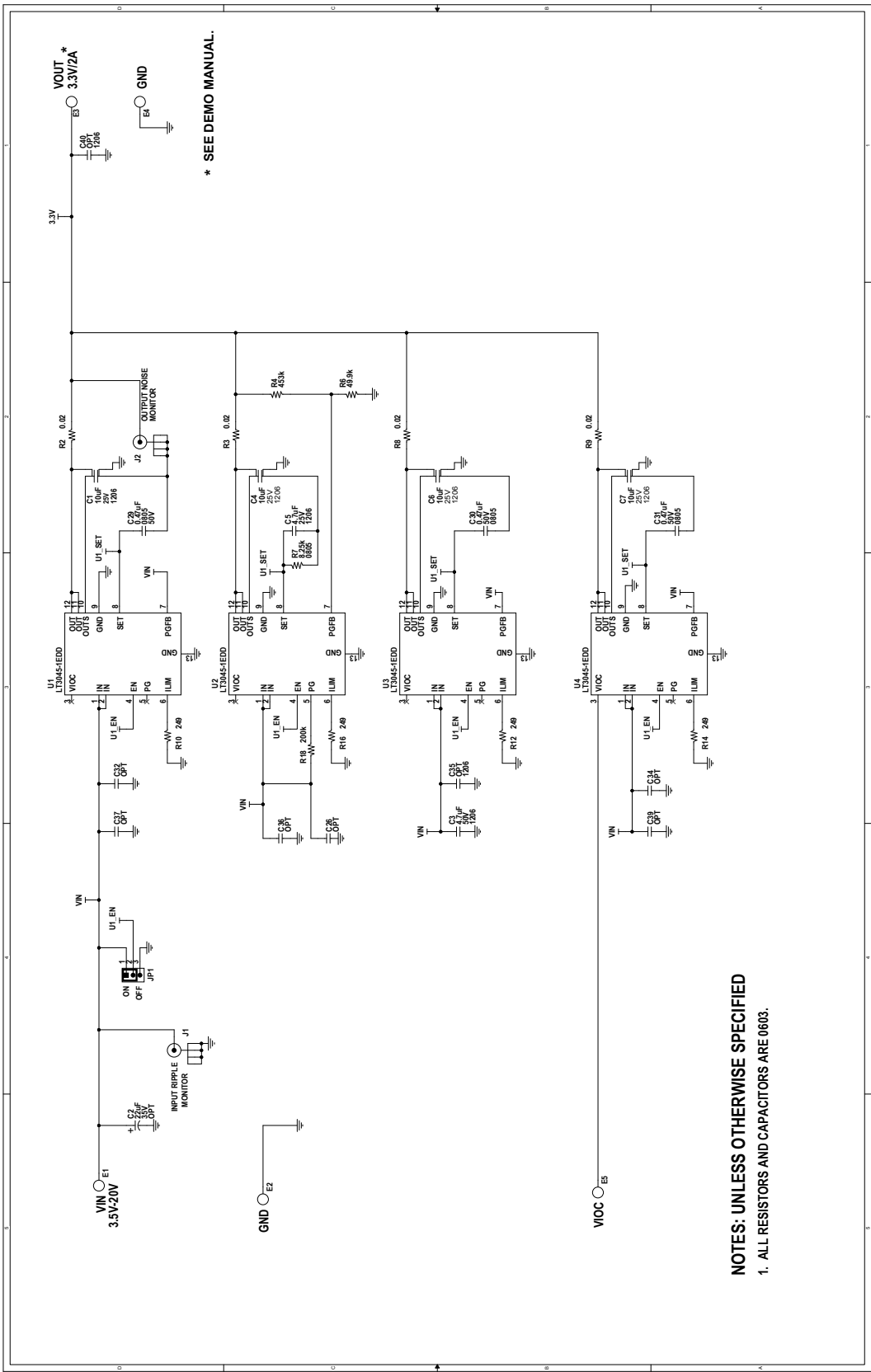
Figure 5. Split Pads for Output Capacitors on Top Layer of DC2637A

DEMO MANUAL DC2637A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	4	C1, C4, C6, C7	CAP., 10 μ F, X5R, 25V, 10%, 1206	MURATA, GJ831CR61E106KE83L
2	1	C2	CAP., 22 μ F, 35V, 20%, 5X5.4mm	SUN ELECTRONIC INDUSTRIES CORP, 35CE22BSS
3	3	C29, C30, C31	CAP., 0.47 μ F, X7R, 50V, 10%, 0805	MURATA, GRM21BR71H474KA88L
4	1	C3	CAP., 4.7 μ F, X7R, 50V, 10%, 1206	MURATA, GRM31CR71H475KA12L
5	1	C5	CAP., 4.7 μ F, X7R, 25V, 10%, 1206	MURATA, GRM31CR71E475KA88L
6	1	R18	RES., 200k, 1%, 1/10W, 0603	VISHAY, CRCW0603200KFKEA
7	4	R2, R3, R8, R9	RES., 0.02 Ω , 1%, 1/5W, 0603	VISHAY, RCWE060320L0FQEA
8	4	R10, R12, R14, R16	RES., 249 Ω , 1%, 1/10W, 0603	VISHAY, CRCW0603249RFKEA
9	1	R4	RES., 453k, 1%, 1/10W, 0603	VISHAY, CRCW0603453KFKEA
10	1	R6	RES., 49.9k, 1%, 1/10W, 0603	VISHAY, CRCW060349K9FKEA
11	1	R7	RES., 8.25k, 1%, 1/10W, 0805	VISHAY, CRCW06038K25FKEA
12	4	U1, U2, U3, U4	IC, LT3045EDD-1 12PIN DFN 3X3MM	LINEAR TECHNOLOGY, LT3045-1EDD#PB
Additional Demo Board Circuit Components				
1	1	C35, C40	CAP., OPTION, 1206	
2	6	C26, C32, C34, C36, C37, C39	CAP., 0603, OPTION	
Hardware: For Demo Board Only				
1	5	E1, E2, E3, E4, E5	TEST POINT, TURRET, 0.094", MTG. HOLE	MILL-MAX, 2501-2-00-80-00-00-07-0
2	1	JP1	CONN., HDR, MALE, 2x3, 2mm, THT, STR	WURTH ELEKTRONIK, 62000621121
3	1	XJP1	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421
4	2	J1, J2	CONN., RF, BNC, RCPT, THT, STR, 5-PIN	AMPHENOL CONNEX, 112404
5	4	MH1, MH2, MH3, MH4	STANDOFF, NYLON, SNAP-ON, 0.250"	WURTH ELEKTRONIK, 702931000

SCHEMATIC DIAGRAM



DEMO MANUAL DC2637A



ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.



**Стандарт
Электрон
Связь**

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

Наши контакты:

Телефон: +7 812 627 14 35

Электронная почта: sales@st-electron.ru

Адрес: 198099, Санкт-Петербург,
Промышленная ул, дом № 19, литера Н,
помещение 100-Н Офис 331