

### FEATURES

- Low input offset voltage:**  $\leq 0.2$  mV typical
- High output current drive:** 20mA, 50 mA
- Wide range of operating voltage:**  $\pm 5$  V to  $\pm 50$  V
- Specified at  $\pm 5$  V,  $\pm 24$  V, and  $\pm 50$  V**
- High slew rate:** 20 V/ $\mu$ s typical
- High gain bandwidth product:**  $\geq 3$  MHz typical
- On-board thermal shutdown at 165°C**
- Ambient temperature range of  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$**
- Low input bias current:**  $I_{\text{BIAS}} \leq 15$  nA typical

### APPLICATIONS

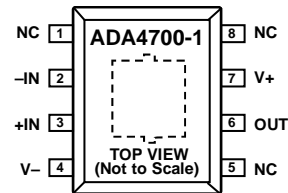
- Automated and bench top test equipment**
- High voltage regulators and power amplifiers**
- Data acquisition and signal conditioning**
- Piezo drivers and predrivers**
- General-purpose current sensing**

### GENERAL DESCRIPTION

The ADA4700-1 is a high voltage precision operational amplifier with a wide operating voltage ( $\pm 5$  V to  $\pm 50$  V) and relatively high output current drive available as a single op amp in an SOIC package. It combines low power consumption, high bandwidth, and a slew rate with unity-gain stability and phase inversion free performance. The ability to swing near rail-to-rail at the output enables designers to maximize signal-to-noise ratios (SNRs).

The ADA4700-1 is designed for applications requiring both ac and precision dc performance, making the ADA4700-1 useful in a wide variety of applications, including high voltage test equipment and instrumentation, high voltage regulators and power amplifiers, power supply control and protection, and as an amplifier or buffer for transducers with wide output ranges. It is particularly well suited for high intensity LED testing applications where it provides highly accurate voltage and current feedback as well as a predriver to provide accurate voltage and/or current sourcing stimulus to the LED string under test.

### PIN CONFIGURATION



#### NOTES

1. NC = NO CONNECT. DO NOT CONNECT TO THIS PIN.
2. THE EXPOSED PAD MUST BE CONNECTED TO V-.

11651-001

Figure 1.

The ADA4700-1 is specified over the industrial temperature range of  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$  and includes an on-board thermal shutdown at  $165^\circ\text{C}$  internal junction temperature as well as an internal current limit for safety. The ADA4700-1 is available in a thermally enhanced, 8-lead SOIC package that uses a small exposed metal pad on the bottom of the package to allow the customer to heat sink the part to the printed circuit board (PCB). For proper operation, the exposed pad must be connected to V-.

#### Rev. PrB

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## SPECIFICATIONS

### $V_{SY} = \pm 50$ V ELECTRICAL CHARACTERISTICS

$V_{SY} = \pm 50$  V,  $V_{CM} = V_{SY}/2$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise specified.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$		0.2	2	mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$			2.5	mV
Input Bias Current	$I_B$	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$		2	13	$\mu\text{V}/^\circ\text{C}$
Input Offset Current	$I_{OS}$	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$		15	30	nA
Input Voltage Range	IVR	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$			50	nA
Common-Mode Rejection Ratio	CMRR	$(V-) + 3 \text{ V} < V_{CM} < (V+) - 3 \text{ V}$ $-40^\circ\text{C} < T_A < +85^\circ\text{C}$	$(V-) + 3$	103	$(V+) - 3$	nA
Large Signal Voltage Gain	$A_{VO}$	$-47 \text{ V} < V_{OUT} < +47 \text{ V}$ , $R_L = 2 \text{ k}\Omega$ $-40^\circ\text{C} < T_A < +85^\circ\text{C}$	103	106	30	nA
Input Capacitance						
Common-Mode	$C_{INCM}$			TBD		pF
Differential	$C_{INDM}$			TBD		pF
Input Resistance	$R_{IN}$	Common mode and differential mode		TBD		M $\Omega$
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High		$R_L = 10 \text{ k}\Omega$ to GND $-40^\circ\text{C} < T_A < +85^\circ\text{C}$	48	48.5		V
		$R_L = 2 \text{ k}\Omega$ to GND $-40^\circ\text{C} < T_A < +85^\circ\text{C}$	47.8			V
Output Voltage Low		$R_L = 10 \text{ k}\Omega$ to GND $-40^\circ\text{C} < T_A < +85^\circ\text{C}$	47.5	48		V
		$R_L = 2 \text{ k}\Omega$ to GND $-40^\circ\text{C} < T_A < +85^\circ\text{C}$	47.3			V
Capacitive Load Drive	$C_L$	$A_V = +1$		-48.5	-48	V
		$A_V = +10$			-47.8	V
Short Circuit Limit	$I_{SC}$	Sourcing and sinking	TBD	TBD		mA
Closed-Loop Impedance	$Z_{OUT}$	$f = 10 \text{ MHz}$ , $A_V = +1$		-48	-47.5	V
					-47.3	V
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = \pm 4.5 \text{ V}$ to $\pm 5 \text{ V}$ $-40^\circ\text{C}$ to $+85^\circ\text{C}$	110	130		dB
Supply Current per Amplifier	$I_{SY}$	$V_O = V_S/2$ $-40^\circ\text{C} < T_A < +85^\circ\text{C}$	110	1.7	2.2	dB
					2.4	mA
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$V_O = \pm 45 \text{ V}$ step, $R_L = 2 \text{ k}\Omega$ , $C_L = 300 \text{ pF}$		20		V/ $\mu\text{s}$
Gain Bandwidth Product	GBP	$V_{IN} = 5 \text{ mV}$ p-p, $A_V = +100$		2.5		MHz
Unity-Gain Crossover	UGC	$V_{IN} = 5 \text{ mV}$ p-p, $A_V = +1$		TBD		MHz
-3 dB Bandwidth	-3 dB	$V_{IN} = 5 \text{ mV}$ p-p, $A_V = -1$		TBD		MHz
Phase Margin	$\Phi_M$	$V_{IN} = 5 \text{ mV}$ p-p, $R_L = 1 \text{ M}\Omega$ , $C_L = 35 \text{ pF}$ ; $A_V = -1$		65		Degrees
Settling Time to 0.1%	$t_s$	$V_{IN} = 30 \text{ V}$ p-p, $R_L = 10 \text{ k}\Omega$ , $C_L = 5 \text{ pF}$ , $A_V = -1$		TBD		$\mu\text{s}$
Settling Time to 0.01%	$t_s$	$V_{IN} = 30 \text{ V}$ p-p, $R_L = 10 \text{ k}\Omega$ , $C_L = 5 \text{ pF}$ , $A_V = -1$		TBD		$\mu\text{s}$

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
NOISE PERFORMANCE						
Total Harmonic Distortion + Noise	THD + N	G= +1, V <sub>IN</sub> = 10 V <sub>p-p</sub> at 1 kHz; R <sub>L</sub> = 10kΩ				
Bandwidth = 80 kHz				TBD		%
Bandwidth = 500 kHz				TBD		%
Peak-to-Peak Noise	e <sub>n p-p</sub>	f = 0.1 Hz to 10 Hz		TBD		μV p-p
Voltage Noise Density	e <sub>n</sub>	f = 1 kHz		13		nV/√Hz
		f = 10 Hz		40		nV/√Hz
Current Noise Density	i <sub>n</sub>	f = 1 kHz		TBD		fA/√Hz

**V<sub>SY</sub> = ±24 V ELECTRICAL CHARACTERISTICS**

V<sub>SY</sub> = ±24 V, V<sub>CM</sub> = V<sub>SY</sub>/2, T<sub>A</sub> = 25°C, unless otherwise specified.

**Table 2.**

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	V <sub>OS</sub>	–40°C < T <sub>A</sub> < +85°C		0.2	2	mV
					2.5	mV
Offset Voltage Drift	ΔV <sub>OS</sub> /ΔT	–40°C < T <sub>A</sub> < +85°C		2.5	15	μV/°C
Input Bias Current	I <sub>B</sub>	–40°C < T <sub>A</sub> < +85°C		5	30	nA
					50	nA
Input Offset Current	I <sub>OS</sub>	–40°C < T <sub>A</sub> < +85°C		2	25	nA
					30	nA
Input Voltage Range	IVR	–40°C < T <sub>A</sub> < +85°C	(V–) + 3		(V+) – 3	V
Common-Mode Rejection Ratio	CMRR	(V–) + 3 V < V <sub>CM</sub> < (V+) – 3 V	100	103		dB
		–40°C < T <sub>A</sub> < +85°C	100			dB
Large Signal Voltage Gain	A <sub>VO</sub>	–21 V < V <sub>OUT</sub> < +21 V, R <sub>L</sub> =2kΩ	103	105		dB
		–40°C < T <sub>A</sub> < +85°C	100			dB
Input Capacitance						
Common-Mode	C <sub>INCM</sub>			TBD		pF
Differential	C <sub>INDM</sub>			TBD		pF
Input Resistance	R <sub>IN</sub>	Common mode and differential mode		TBD		MΩ
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	V <sub>OH</sub>	R <sub>L</sub> = 10 kΩ to GND	22.2	22.5		V
		–40°C < T <sub>A</sub> < +85°C	22.0			V
		R <sub>L</sub> = 2 kΩ to GND	22.0	22.4		V
		–40°C < T <sub>A</sub> < +85°C	21.8			V
Output Voltage Low	V <sub>OL</sub>	R <sub>L</sub> = 10 kΩ to GND		–22.5	–22.2	V
		–40°C < T <sub>A</sub> < +85°C			–22.0	V
		R <sub>L</sub> = 2 kΩ to GND		–22.4	–22.0	V
		–40°C < T <sub>A</sub> < +85°C			–21.8	V
Capacitive Load Drive	C <sub>L</sub>	A <sub>V</sub> = +1		TBD		nF
		A <sub>V</sub> = +10		TBD		nF
Short Circuit Limit	I <sub>SC</sub>	Sourcing and sinking	TBD	TBD		mA
Closed-Loop Impedance	Z <sub>out</sub>	f = 10 MHz, A <sub>V</sub> = +1		TBD		Ω
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	V <sub>S</sub> = ±4.5 V to ±55 V	110	130		dB
		–40°C to +85°C	TBD			dB
Supply Current per Amplifier	I <sub>SY</sub>	V <sub>O</sub> = V <sub>S</sub> /2		1.65	2.1	mA
		–40°C < T <sub>A</sub> < +85°C			TBD	mA
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	V <sub>O</sub> = TBD V step, R <sub>L</sub> = 2 kΩ, C <sub>L</sub> = 100 pF		20		V/μs
Gain Bandwidth Product	GBP	V <sub>IN</sub> = 5 mV p-p, A <sub>V</sub> = +100		2.5		MHz
Unity Gain Crossover	UGC	V <sub>IN</sub> = 5 mV p-p, A <sub>V</sub> = +1		TBD		MHz
–3 dB Bandwidth	–3 dB	V <sub>IN</sub> = 5 mV p-p, A <sub>V</sub> = –1		TBD		MHz
Phase Margin	ΦM	V <sub>IN</sub> = 5 mV p-p, R <sub>L</sub> = 1MΩ, C <sub>L</sub> = 35 pF; A <sub>V</sub> =-1		65		Degrees
Settling Time to 0.1%	t <sub>s</sub>	V <sub>IN</sub> = 20 V p-p, R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 5 pF, A <sub>V</sub> = -1		TBD		μs
Settling Time to 0.01%	t <sub>s</sub>	V <sub>IN</sub> = 20 V p-p, R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 5 pF, A <sub>V</sub> = -1		TBD		μs

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
NOISE PERFORMANCE						
Total Harmonic Distortion + Noise	THD + N	G = +1, V <sub>IN</sub> = 10 V p-p at 1 kHz; R <sub>L</sub> = 10kΩ				
Bandwidth = 80 kHz				TBD		%
Bandwidth = 500 kHz				TBD		%
Peak-to-Peak Noise	e <sub>n p-p</sub>	f = 0.1 Hz to 10 Hz		TBD		μV p-p
Voltage Noise Density	e <sub>n</sub>	f = 1 kHz		13		nV/√Hz
		f = 10 Hz		40		nV/√Hz
Current Noise Density	i <sub>n</sub>	f = 1 kHz		TBD		fA/√Hz

**V<sub>SY</sub> = ±5 V ELECTRICAL CHARACTERISTICS**

V<sub>SY</sub> = ±5 V, V<sub>CM</sub> = V<sub>SY</sub>/2, T<sub>A</sub> = 25°C, unless otherwise specified.

Table 3.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	V <sub>OS</sub>	–40°C < T <sub>A</sub> < +85°C		0.2	2	mV
Offset Voltage Drift	ΔV <sub>OS</sub> /ΔT	–40°C < T <sub>A</sub> < +85°C		3	2.5	μV/°C
Input Bias Current	I <sub>B</sub>	–40°C < T <sub>A</sub> < +85°C		5	30	nA
Input Offset Current	I <sub>OS</sub>	–40°C < T <sub>A</sub> < +85°C		2	25	nA
Input Voltage Range	IVR	–40°C < T <sub>A</sub> < +85°C	–2		30	V
Common-Mode Rejection Ratio	CMRR	–2 V ≤ V <sub>CM</sub> ≤ +2 V	86	89		dB
Large Signal Voltage Gain	A <sub>VO</sub>	–40°C < T <sub>A</sub> < +85°C	86			dB
		–2 V < V <sub>OUT</sub> < +2 V, R <sub>L</sub> = 2kΩ	97	99		dB
		–40°C < T <sub>A</sub> < +85°C	95			dB
Input Capacitance						
Common-Mode	C <sub>INCM</sub>			TBD		pF
Differential	C <sub>INDM</sub>			TBD		pF
Input Resistance	R <sub>IN</sub>	Common mode and differential mode		TBD		MΩ
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	V <sub>OH</sub>	R <sub>L</sub> = 2 kΩ to GND	3.4	3.6		V
		–40°C < T <sub>A</sub> < +85°C	3.2			V
Output Voltage Low	V <sub>OL</sub>	R <sub>L</sub> = 2 kΩ to GND		–3.6	–3.4	V
		–40°C < T <sub>A</sub> < +85°C			–3.2	V
Capacitive Load Drive	C <sub>L</sub>	A <sub>V</sub> = +1		TBD		nF
		A <sub>V</sub> = +10		TBD		nF
Short Circuit Limit	I <sub>SC</sub>	Sourcing and sinking	TBD	±75		mA
Closed-Loop Impedance	Z <sub>out</sub>	f = 10 MHz, A <sub>V</sub> = +1		TBD		Ω
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	V <sub>S</sub> = ±4.5 V to ±55 V	110	130		dB
		–40°C to +85°C	110			dB
Supply Current per Amplifier	I <sub>SY</sub>	V <sub>O</sub> = V <sub>S</sub> /2		1.5	2	mA
		–40°C < T <sub>A</sub> < +85°C			2.2	mA
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	V <sub>O</sub> = TBD V step, R <sub>L</sub> = 2 kΩ, C <sub>L</sub> = 100 pF		TBD		V/μs
Gain Bandwidth Product	GBP	V <sub>IN</sub> = 5 mV p-p, A <sub>V</sub> = +100		2.5		MHz
Unity Gain Crossover	UGC	V <sub>IN</sub> = 5 mV p-p, A <sub>V</sub> = +1		TBD		MHz
–3 dB Bandwidth	–3 dB	V <sub>IN</sub> = 5 mV p-p, A <sub>V</sub> = –1		TBD		MHz
Phase Margin	ΦM	V <sub>IN</sub> = 5 mV p-p, R <sub>L</sub> = 1MΩ, C <sub>L</sub> = 35 pF; A <sub>V</sub> = –1		65		Degrees
Settling Time to 0.1%	t <sub>s</sub>	V <sub>IN</sub> = 6 V p-p, R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 5 pF, A <sub>V</sub> = –1		TBD		μs
<b>NOISE PERFORMANCE</b>						
Total Harmonic Distortion + Noise	THD + N	G = +1, V <sub>IN</sub> = 3V <sub>p-p</sub> at 1 kHz; R <sub>L</sub> = 10kΩ				
Bandwidth = 80 kHz				TBD		%
Bandwidth = 500 kHz				TBD		%
Peak-to-Peak Noise	e <sub>n p-p</sub>	f = 0.1 Hz to 10 Hz		TBD		μV p-p
Voltage Noise Density	e <sub>n</sub>	f = 1 kHz		13		nV/√Hz
Current Noise Density	i <sub>n</sub>	f = 1 kHz		TBD		fA/√Hz

## ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Rating
Supply Voltage	110 V
Input Voltage	$V- \leq V_{IN} \leq V+$
Differential Input Voltage	$V- \leq V_{IN} \leq V+$
Storage Temperature Range	-65°C to +150°C
Operating Temperature Range	-40°C to +85°C
Junction Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 60 sec)	300°C

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by a plastic encapsulated package is limited by the junction temperature. The maximum safe junction temperature for plastic encapsulated devices, as determined by the glass transition temperature of the plastic, is approximately 150°C. Exceeding this limit temporarily

may cause a shift in the parametric performance due to a change in the stresses exerted on the die by the package. Exceeding a junction temperature of 175°C for an extended period can result in device failure.

### THERMAL RESISTANCE

$\theta_{JA}$  is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Table 5. Thermal Resistance

Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
8-Lead SOIC_N_EP (RD-8-2)	TBD	TBD	°C/W

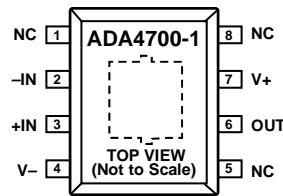
### ESD CAUTION



**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.



## PIN CONFIGURATION AND FUNCTION DESCRIPTION



- NOTES**  
 1. NC = NO CONNECT. DO NOT CONNECT TO THIS PIN.  
 2. THE EXPOSED PAD MUST BE CONNECTED TO V-.

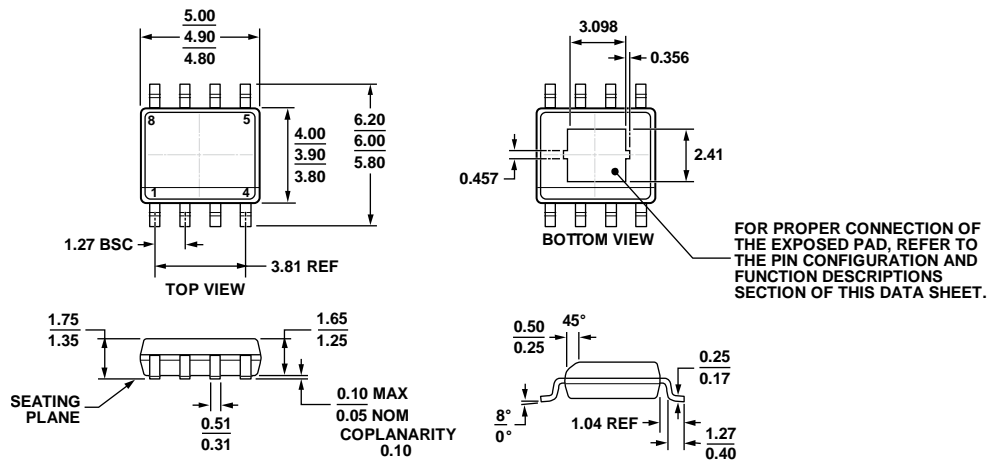
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Figure 2. Pin Configuration

Table 6. Pin Function Descriptions

Pin No.	Mnemonic	Description
1, 5, 8	NC	No Connect. Do not connect to this pin.
2	-IN	Inverting Input.
3	+IN	Noninverting Input.
4	V-	Negative Supply Voltage.
6	OUT	Output.
7	V+	Positive Supply Voltage.
	EPAD	Exposed Pad. Connect the exposed pad to V-.

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-012-AA

Figure 3. 8-Lead Standard Small Outline Package with Exposed Pad [SOIC\_N\_EP] Narrow Body (RD-8-2) Dimensions shown in millimeters

ORDERING GUIDE

Model <sup>1</sup>	Temperature Range	Package Description	Package Option	Branding
ADA4700-1ARDZ	-40°C to +85°C	8-Lead Standard Small Outline Package with Exposed Pad [SOIC_N_EP]	RD-8-2	??
ADA4700-1ARDZ-R7	-40°C to +85°C	8-Lead Standard Small Outline Package with Exposed Pad [SOIC_N_EP]	RD-8-2	
ADA4700-1ARDZ-RL	-40°C to +85°C	8-Lead Standard Small Outline Package with Exposed Pad [SOIC_N_EP]	RD-8-2	

<sup>1</sup> Z = RoHS Compliant Part.



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

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- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
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- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.