



SANYO Semiconductors

## DATA SHEET

An ON Semiconductor Company

# LC898300XA — CMOS LSI Linear Vibrator Driver IC

## Overview

LC898300XA is a Linear Vibrator Driver IC for a haptics and a vibrator installed in mobile equipments. The best feature is it can adjust the drive frequency to the resonance frequency of the linear vibrator automatically without external parts. As a result, the vibration power is not influenced by the difference of the resonance frequency and it is not necessary to care about the shift of resonance frequency with the lapse of time or the impact of fall. And it is possible to improve the brake performance with the automatic brake function. Moreover, it is possible to reduce the power consumption by highly effective drive.

## Functions

- Automatic adjustment to the individual resonance frequency
- Initial drive frequency adjustment function
- Various drive pattern with I<sup>2</sup>C\* IF setting (1.8V IF is available)
- Low power consumption by highly effective drive (100degree drive)
- Automatic brake function
- Drive voltage adjustment with I<sup>2</sup>C IF setting
- Low driving noise

## Applications

- Linear Vibrator (Vibration and haptics)
- Portable Game
- Mobile Phone
- Mobile equipment with haptics function

## Specifications

### Absolute Maximum Ratings at V<sub>SS</sub> = 0V

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage range	V <sub>DD</sub> max		-0.3 to 4.6	V
Input voltage	V <sub>I1</sub>		-0.3 to V <sub>DD</sub> +0.3	V
	V <sub>I2</sub>	*1	-0.3 to 5.8	V
Output voltage	V <sub>O</sub>		-0.3 to V <sub>DD</sub> +0.3	V
H-bridge Drive current	I <sub>O</sub> max		150	mA
Allowable power dissipation	P <sub>d</sub> max	T <sub>a</sub> = 85°C *2	170	mW
Operating temperature range	T <sub>a</sub>		-30 to 85	°C

Continued on next page.

\* I<sup>2</sup>C Bus is a trademark of Philips Corporation.

■ Any and all SANYO Semiconductor Co.,Ltd. products described or contained herein are, with regard to "standard application", intended for the use as general electronics equipment. The products mentioned herein shall not be intended for use for any "special application" (medical equipment whose purpose is to sustain life, aerospace instrument, nuclear control device, burning appliances, transportation machine, traffic signal system, safety equipment etc.) that shall require extremely high level of reliability and can directly threaten human lives in case of failure or malfunction of the product or may cause harm to human bodies, nor shall they grant any guarantee thereof. If you should intend to use our products for new introduction or other application different from current conditions on the usage of automotive device, communication device, office equipment, industrial equipment etc. , please consult with us about usage condition (temperature, operation time etc.) prior to the intended use. If there is no consultation or inquiry before the intended use, our customer shall be solely responsible for the use.

■ Specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.

SANYO Semiconductor Co., Ltd.

<http://semicon.sanyo.com/en/network>

# LC898300XA

Continued from preceding page.

Parameter	Symbol	Conditions	Ratings	Unit
Storage temperature range	Tstg		-55 to 125	°C
Input or Output current	I <sub>I</sub> , I <sub>O</sub>	*3	±20	mA

\*1: Input voltage without diode connection to V<sub>DD</sub>. (SDA, SCL)

\*2: Grass epoxy (50mm × 40mm × 0.9mm<sup>3</sup>, FR-4)

\*3: Per an I/O buffer

## Recommended Operating Conditions at Ta = -30 to 85°C, V<sub>SS</sub> = 0V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage range	V <sub>DD</sub>		2.7	3.0	3.3	V
Input voltage range	V <sub>IN1</sub>		0	-	V <sub>DD</sub>	V

\*1: Input voltage without diode connection to V<sub>DD</sub>. (SDA, SCL)

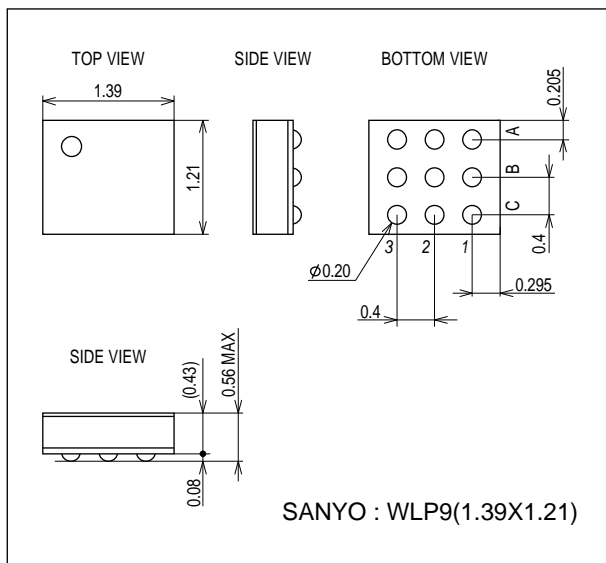
## Electrical Characteristics

Parameter	Symbol	Conditions	Applied pin	Ratings			Unit
				min	typ	max	
DC characteristics at V <sub>SS</sub> = 0V, V <sub>DD</sub> = 2.7 to 3.3V, Ta = -30 to 85°C							
High level input voltage	V <sub>IH1</sub>	CMOS	TEST	0.7V <sub>DD</sub>	-	-	V
Low level input voltage	V <sub>IL1</sub>			-	-	0.2V <sub>DD</sub>	V
High level input voltage	V <sub>IH2</sub>	CMOS	EN	1.5	-	-	V
Low level input voltage	V <sub>IL2</sub>			-	-	0.36	V
High level input voltage	V <sub>IH3</sub>	CMOS Schmitt	RSTB, SDA , SCL	1.5	-	-	V
Low level input voltage	V <sub>IL3</sub>			-	-	0.36	V
Low level output voltage	V <sub>OL</sub>	I <sub>OL</sub> = 4mA	SDA	-	-	0.4	V
Input leakage current	I <sub>IL</sub>	V <sub>I</sub> = V <sub>DD</sub> , V <sub>SS</sub>	RSTB, EN , SDA, SCL	-10	-	+10	μA
Analog characteristics at V <sub>SS</sub> = 0V, V <sub>DD</sub> = 3V, Ta = 25°C							
H-bridge ON resistance Pch	R <sub>ONP</sub>	I <sub>F</sub> = 100mA		-	2.5	-	Ω
H-bridge ON resistance Nch	R <sub>ONN</sub>	I <sub>S</sub> = 100mA		-	1.5	-	Ω
Adjustable resonance frequency range	F <sub>mo</sub>	vs typ value		-10	-	+10	%

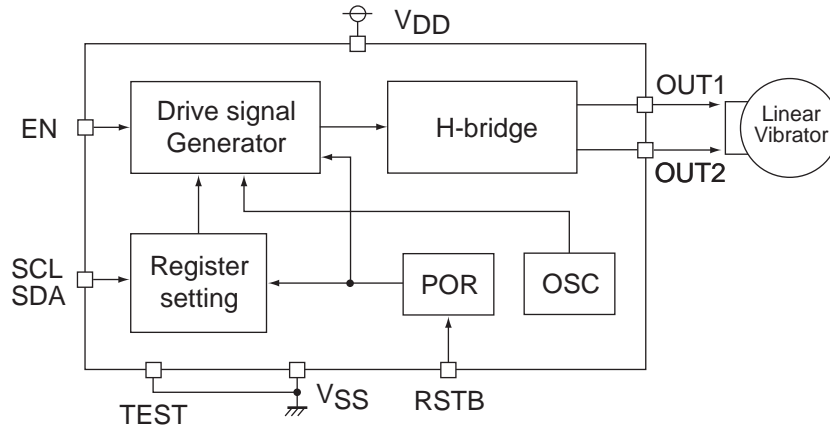
## Package Dimensions

unit : mm (typ)

3429



## Block Diagram



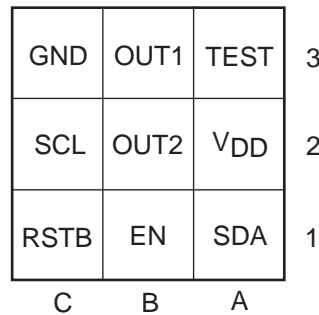
## Pin Assignment

Pin list

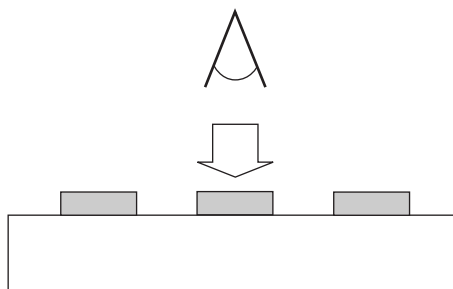
I/O ( I: input, O: output, B: bi-direction, P: power supply, NC: not connected )

No	Name	I/O	No	Name	I/O	No	Name	I/O
1A	SDA	B	1B	EN	I	1C	RSTB	I
2A	V <sub>DD</sub>	P	2B	OUT2	O	2C	SCL	I
3A	TEST	I	3B	OUT1	O	3C	GND	P

Pin layout



< Bottom View >



Pin description

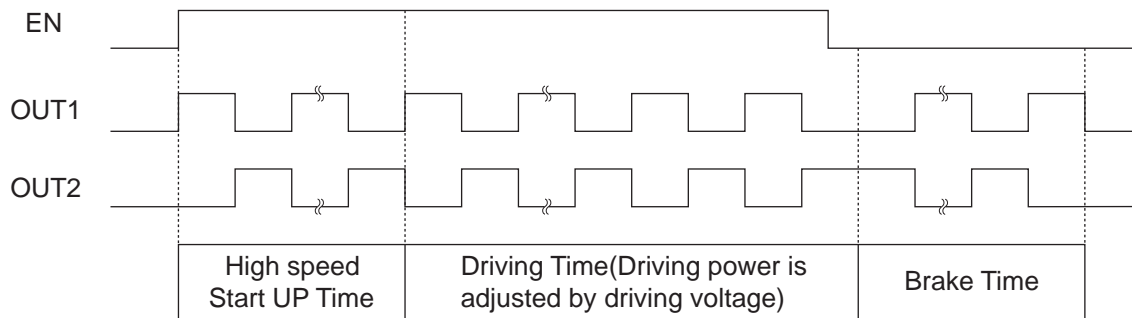
I/O ( I: input, O: output, B: bi-direction, P: power supply, NC: not connected )

Signal name	I/O	Function	Remarks
OUT1	O	Motor drive pin	H-bridge output
OUT2	O	Motor drive pin	H-bridge output
RSTB	I	Reset and standby control	L: enable, H: disable
EN	I	Motor drive ON/OFF	L: disable, H: enable
SCL	I	I <sup>2</sup> C I/F clock pin	
SDA	B	I <sup>2</sup> C I/F data pin	Open drain
TEST	I	TEST pin	L: disable, H: enable (normally Low fix)
V <sub>DD</sub>	P	Power supply pin	
V <sub>SS</sub>	P	GND pin	

## Timing chart

### Motor drive timing

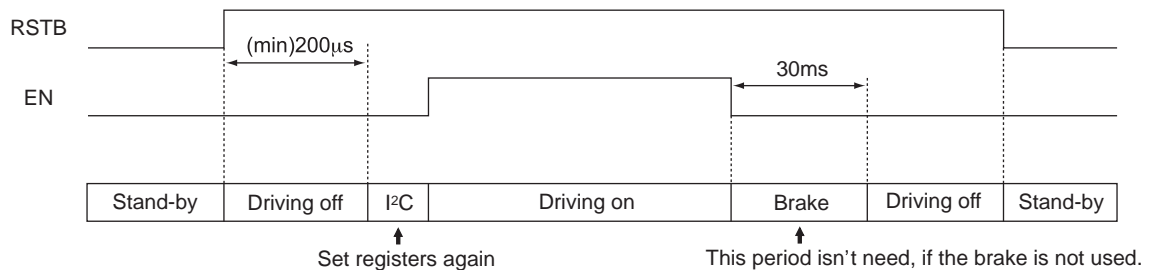
The Motor is driven by EN pin, and the driving time is controlled by keeping EN pin “H”. The High speed start UP time, driving power and Brake time can be modified by I<sup>2</sup>C setting. The initial driving frequency must be set by I<sup>2</sup>C I/F at the center of resonance frequency of the linear vibrators, when the initial driving frequency is inadequate. The minimum width of EN signal must be larger than the cycle of initial driving frequency setting.



### Stand-by Control

The Stand-by mode is controlled by RSTB pin. (RSTB="L" → Stand-by mode is ON.)

When the stand-by mode is “ON”, the register value is set to initial value. So, the register must be set again after the stand-by mode is “OFF”. And, the “EN” signal and I2C command must wait over 200us after “RSTB” pin is set to “H”.

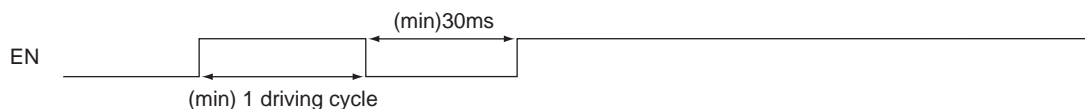


### EN Control

The width of EN=High should be set at least 1 driving cycle.

ex) 0x02 RESOFRQ=0x0A (175Hz) → (min) 5.71ms

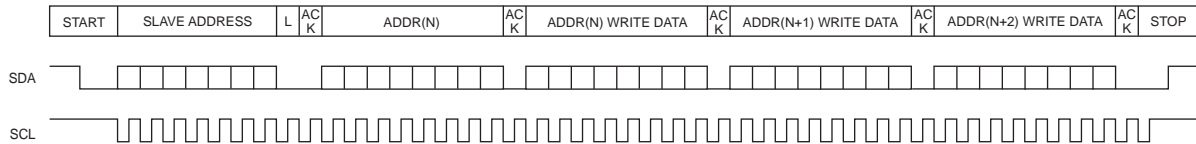
The width of EN=Low should be kept over 30ms, if the pre-driving period is over 30ms. On the other hand, If the pre-driving period is less than 30ms, the minimum width of EN=Low is same as the pre-driving width.



## I<sup>2</sup>C Serial Interface

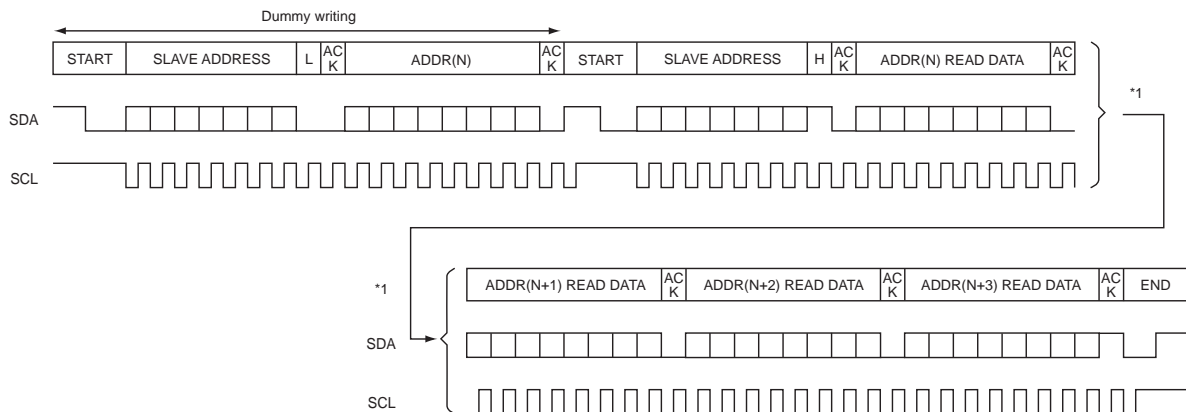
Writing format (Sequential Writing is possible)

After the start condition, slave address (7bit) and “L”(Write mode) are received, the flag “ACK=L” is replied. Next, after the 8bit address is received, the flag “ACK=L” is replied. Next, after the 8bit write data is received, the flag “ACK=L” is replied. Next, when the stop condition is received, the write data can be written in the specified address. Moreover, it is possible to write data in the incremental address by the continuous input of the 8bit data confirming the flag “ACK=L” after the every 8bit write data input.



Reading format (Sequential Reading is possible)

After the dummy writing, the start condition, slave address (7bit) and “H”(Read mode) are received, the flag “ACK=L” is replied. Next, the 8bit read data is output. After them, when the stop condition is not received, and the read condition is continued, the read data of incremental address is output one by one. The read condition is end when the end condition is received after the flag “ACK=H”.



Slave Address

The Slave Address is as follows.

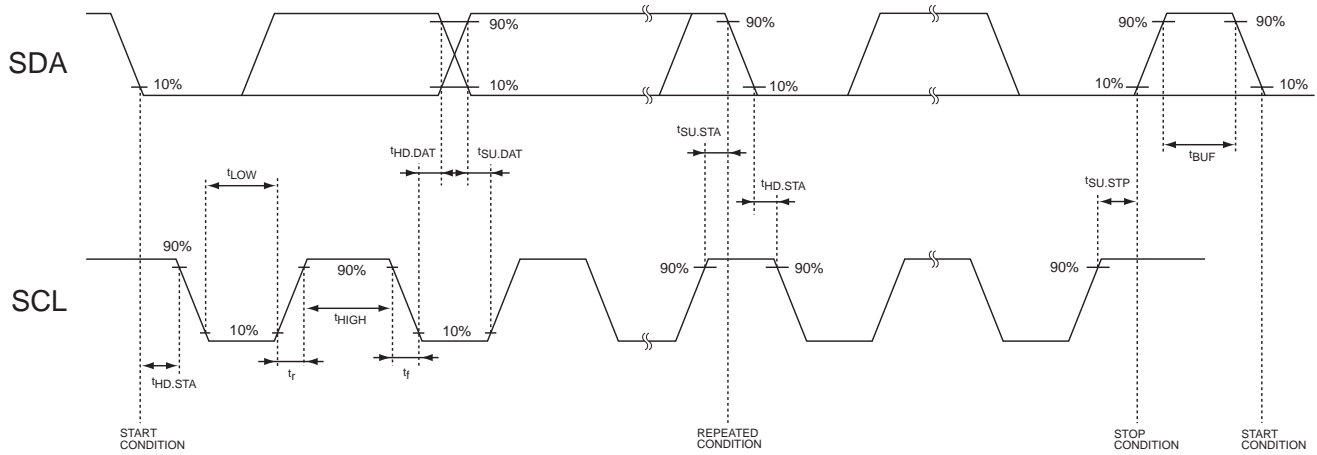
Slave Address	1001001
---------------	---------

## LC898300XA

AC Characteristics (I<sup>2</sup>C Serial Interface) at V<sub>SS</sub> = 0V, V<sub>DD</sub> = 2.7 to 3.3V, Ta = -30 to 85°C

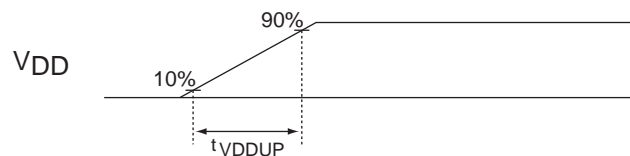
Parameter	Symbol	Pin	Min	Typ	Max	Unit	comment
SCL clock frequency	f <sub>SCL</sub>	SCL	-	-	400	kHz	
START condition Hold time	t <sub>HD,STA</sub>	SCL SDA	0.6	-	-	us	
SCL clock Low width	t <sub>LOW</sub>	SCL	1.3	-	-	us	
SCL clock High width	t <sub>HIGH</sub>	SCL	0.6	-	-	us	
RE-START condition Setup time	t <sub>SU,STA</sub>	SCL SDA	0.6	-	-	us	
SDA Hold time	t <sub>HD,DAT</sub>	SCL SDA	0	-	0.9	us	
SDA Setup time	t <sub>SU,DAT</sub>	SCL SDA	0.2	-	-	us	*1
SDA, SCL Rise time	t <sub>r</sub>	SCL SDA		-	0.3	us	*1
SDA, SCL Fall time	t <sub>f</sub>	SCL SDA		-	0.3	us	*1
STOP condition Setup time	t <sub>SU,STP</sub>	SCL SDA	0.6	-	-	us	
STOP to START BUS open time	t <sub>BUF</sub>	SCL SDA	1.3	-	-	us	

\*1) Design Assurance (Shipment test none)



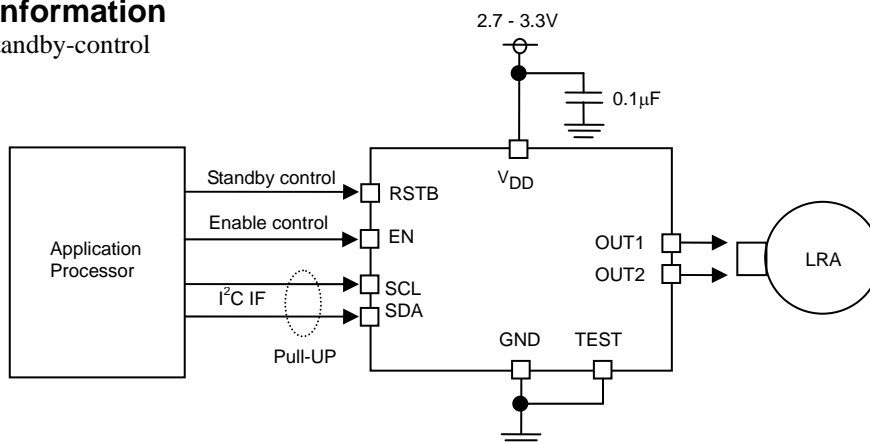
AC Characteristic (Power On Reset) at V<sub>SS</sub> = 0V, V<sub>DD</sub> = 2.7 to 3.3V, Ta = -30 to 85°C

Parameter	Symbol	Min	Typ	Max	Unit	comment
V <sub>DD</sub> Rise Up Time	t <sub>VDDUP</sub>	-	-	100	ms	-



## Application information

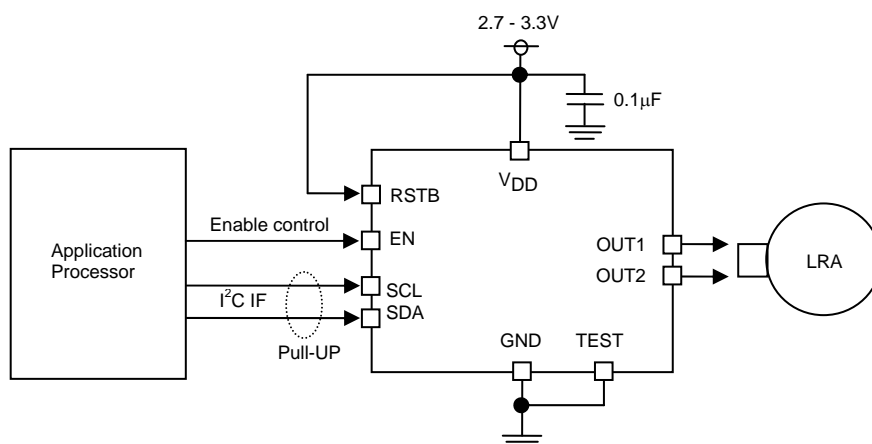
### 1) Case-1: With standby-control



Note) When SDA&SCL signal voltages are different from  $V_{DD}$ , even if the RSTB pin is set to Low, the IO leak current flows.  
ex) In case of  $V_{DD}=3.0V$  &  $SDA=SCL=1.8V$ , the current consumption is about  $100\mu A$ (typ).

### 2) Case-2: Without standby-control

Note) In case of  $V_{DD}=3.0V$ , the current consumption is about  $1.5mA$ (typ).



- SANYO Semiconductor Co.,Ltd. assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein.
- Regarding monolithic semiconductors, if you should intend to use this IC continuously under high temperature, high current, high voltage, or drastic temperature change, even if it is used within the range of absolute maximum ratings or operating conditions, there is a possibility of decrease reliability. Please contact us for a confirmation.
- SANYO Semiconductor Co.,Ltd. strives to supply high-quality high-reliability products, however, any and all semiconductor products fail or malfunction with some probability. It is possible that these probabilistic failures or malfunction could give rise to accidents or events that could endanger human lives, trouble that could give rise to smoke or fire, or accidents that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO Semiconductor Co.,Ltd. products described or contained herein are controlled under any of applicable local export control laws and regulations, such products may require the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written consent of SANYO Semiconductor Co.,Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO Semiconductor Co.,Ltd. product that you intend to use.
- Upon using the technical information or products described herein, neither warranty nor license shall be granted with regard to intellectual property rights or any other rights of SANYO Semiconductor Co.,Ltd. or any third party. SANYO Semiconductor Co.,Ltd. shall not be liable for any claim or suits with regard to a third party's intellectual property rights which has resulted from the use of the technical information and products mentioned above.

This catalog provides information as of August, 2012. Specifications and information herein are subject to change without notice.



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

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- 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.