

ICM7555, ICM7556

General Purpose Timers

FN2867
Rev.10.01
Mar 5, 2020

The [ICM7555](#) and [ICM7556](#) are CMOS RC timers providing significantly improved performance over the standard SE/NE 555/556 and 355 timers, while at the same time being direct replacements for those devices in most applications. Improved parameters include low supply current, wide operating supply voltage range, low Threshold, Trigger and Reset currents, no crowbaring of the supply current during output transitions, higher frequency performance and no requirement to decouple Control Voltage for stable operation.

Specifically, the ICM7555 and ICM7556 are stable controllers capable of producing accurate time delays or frequencies. The ICM7556 is a dual ICM7555, with the two timers operating independently of each other, sharing only V+ and GND. In the one shot mode, the pulse width of each circuit is precisely controlled by one external resistor and capacitor. For astable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled by two external resistors and one capacitor. Unlike the regular bipolar SE/NE 555/556 devices, the Control Voltage terminal need not be decoupled with a capacitor. The circuits are triggered and reset on falling (negative) waveforms, and the output inverter can source or sink currents large enough to drive TTL loads, or provide minimal offsets to drive CMOS loads.

Applications

- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Missing pulse detector

Features

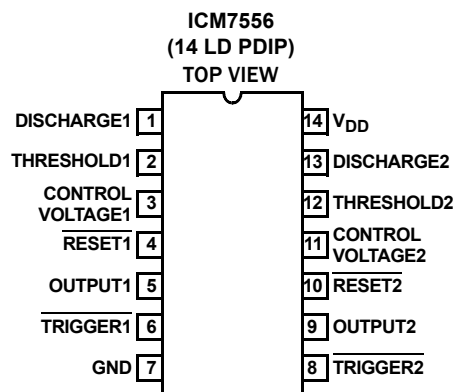
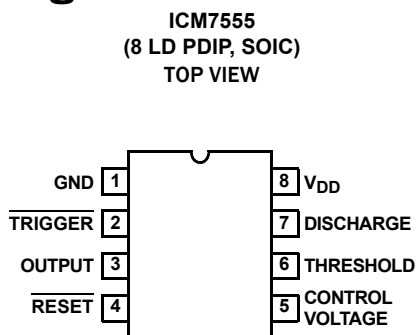
- Exact equivalent in most cases for SE/NE 555/556 or TLC555/556
- Low supply current
 - ICM7555 60µA
 - ICM7556 120µA
- Extremely low input currents 20pA
- High speed operation 1MHz
- Guaranteed supply voltage range 2V to 18V
- Temperature stability 0.005%/°C at +25°C
- Normal reset function - no crowbaring of supply during output transition
- Can be used with higher impedance timing elements than regular 555/556 for longer RC time constants
- Timing from microseconds through hours
- Operates in both astable and monostable modes
- Adjustable duty cycle
- High output source/sink driver can drive TTL/CMOS
- Outputs have very low offsets, HIGH and LOW
- Pb-free (RoHS Compliant)

Related Literature

For a full list of related documents, visit our website:

- [ICM7555](#) and [ICM7556](#) device pages

Pin Configurations



Ordering Information

PART NUMBER	PART MARKING	TEMP. RANGE (°C)	TAPE AND REEL (UNITS)	PACKAGE (RoHS COMPLIANT)	PKG. DWG. #
ICM7555CBAZ (Notes 2, 3)	7555 CBAZ	0 to +70		8 Ld SOIC	M8.15
ICM7555CBAZ-T (Notes 1, 2, 3)	7555 CBAZ	0 to +70	2.5k	8 Ld SOIC	M8.15
ICM7555IBAZ (Notes 2, 3)	7555 IBAZ	-25 to +85		8 Ld SOIC	M8.15
ICM7555IBAZ-T (Notes 1, 2, 3)	7555 IBAZ	-25 to +85	2.5k	8 Ld SOIC	M8.15
ICM7555IPAZ (Notes 2, 3)	7555 IPAZ	-25 to +85		8 Ld PDIP	E8.3
ICM7556IPDZ (Notes 2, 3)	ICM7556IPDZ	-25 to +85		14 Ld PDIP	E14.3

NOTES:

1. Please refer to [IB347](#) for details on reel specifications.
2. These Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J-STD-020.
3. For Moisture Sensitivity Level (MSL), please see product information page for [ICM7555](#), [ICM7556](#). For more information on MSL, please see tech brief [IB363](#).

Absolute Maximum Ratings

Supply Voltage	+18V
Input Voltage	
Trigger, Control Voltage, Threshold,	
Reset (Note 4)	V+ +0.3V to GND -0.3V
Output Current	100mA
ESD Rating	
Human Body Model	2kV
Charged Device Model	100V

Thermal Information

Thermal Resistance (Typical, Notes 5, 6)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
14 Ld PDIP Package*	115	46
8 Ld PDIP Package*	130	69
8 Ld SOIC Package	170	67
Maximum Junction Temperature (Hermetic Package)	+175°C	
Maximum Junction Temperature (Plastic Package)	+150°C	
Maximum Storage Temperature Range	-65°C to +150°C	

* Pb-free PDIPs can be used for through-hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

Operating Conditions

Temperature Range	
ICM7555C	0°C to +70°C
ICM7555I, ICM7556I	-25°C to +85°C

CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

NOTES:

- Due to the SCR structure inherent in the CMOS process used to fabricate these devices, connecting any terminal to a voltage greater than V+ +0.3V or less than V- -0.3V may cause destructive latch-up. For this reason it is recommended that no inputs from external sources not operating from the same power supply be applied to the device before its power supply is established. In multiple supply systems, the supply of the ICM7555 and ICM7556 must be turned on first.
- θ_{JA} is measured with the component mounted on a low effective thermal conductivity test board in free air. See Tech Brief TB379 for details.
- For θ_{JC} , the "case temp" location is taken at the package top center.

Electrical Specifications Applies to ICM7555 and ICM7556, unless otherwise specified.

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A = +25^\circ\text{C}$			UNIT
			MIN	TYP	MAX	
Static Supply Current	I_{DD}	ICM7555	$V_{DD} = 5V$	40	200	μA
			$V_{DD} = 15V$	60	300	μA
		ICM7556	$V_{DD} = 5V$	80	400	μA
			$V_{DD} = 15V$	120	600	μA
Monostable Timing Accuracy		$R_A = 10k, C = 0.1\mu\text{F}, V_{DD} = 5V$		2		%
						μs
Drift with Temperature (Note 7)		$V_{DD} = 5V$				ppm/°C
			$V_{DD} = 10V$			ppm/°C
			$V_{DD} = 15V$			ppm/°C
Drift with Supply (Note 7)		$V_{DD} = 5V \text{ to } 15V$	0.5			%/V
Astable Timing Accuracy		$R_A = R_B = 10k, C = 0.1\mu\text{F}, V_{DD} = 5V$		2		%
						μs
Drift with Temperature (Note 7)		$V_{DD} = 5V$				ppm/°C
			$V_{DD} = 10V$			ppm/°C
			$V_{DD} = 15V$			ppm/°C
Drift with Supply (Note 7)		$V_{DD} = 5V \text{ to } 15V$	0.5			%/V
Threshold Voltage	V_{TH}	$V_{DD} = 15V$	62	67	71	% V_{DD}
Trigger Voltage	V_{TRIG}	$V_{DD} = 15V$	28	32	36	% V_{DD}
Trigger Current	I_{TRIG}	$V_{DD} = 15V$			10	nA
Threshold Current	I_{TH}	$V_{DD} = 15V$			10	nA
Control Voltage	V_{CV}	$V_{DD} = 15V$	62	67	71	% V_{DD}
Reset Voltage	V_{RST}	$V_{DD} = 2V \text{ to } 15V$	0.4		1.0	V

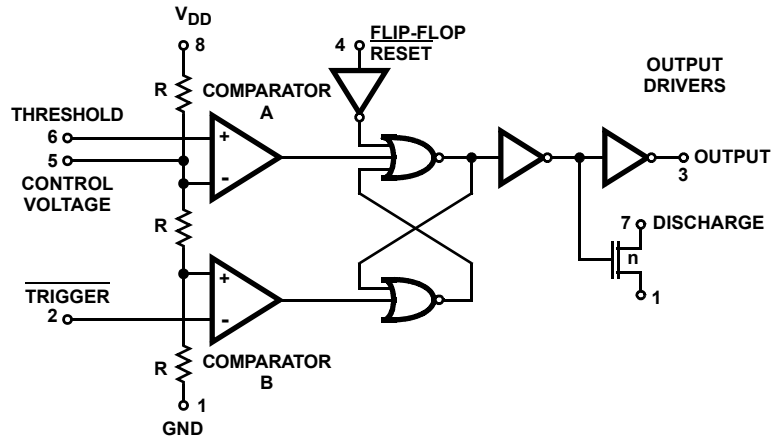
Electrical Specifications Applies to ICM7555 and ICM7556, unless otherwise specified. (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	T _A = +25°C			UNIT
			MIN	TYP	MAX	
Reset Current	I _{RST}	V _{DD} = 15V			10	nA
Discharge Leakage	I _{DIS}	V _{DD} = 15V			10	nA
Output Voltage	V _{OL}	V _{DD} = 15V, I _{SINK} = 20mA		0.4	1.0	V
		V _{DD} = 5V, I _{SINK} = 3.2mA		0.2	0.4	V
	V _{OH}	V _{DD} = 15V, I _{SOURCE} = 0.8mA	14.3	14.6		V
		V _{DD} = 5V, I _{SOURCE} = 0.8mA	4.0	4.3		V
Discharge Output Voltage	V _{DIS}	V _{DD} = 5V, I _{SINK} = 15mA		0.2	0.4	V
		V _{DD} = 15V, I _{SINK} = 15mA				V
Supply Voltage (Note 7)	V _{DD}	Functional Operation	2.0		18.0	V
Output Rise Time (Note 7)	t _R	R _L = 10M, C _L = 10pF, V _{DD} = 5V		75		ns
Output Fall Time (Note 7)	t _F	R _L = 10M, C _L = 10pF, V _{DD} = 5V		75		ns
Oscillator Frequency (Note 7)	f _{MAX}	V _{DD} = 5V, R _A = 470Ω, R _B = 270Ω, C = 200pF		1		MHz

NOTES:

7. These parameters are based upon characterization data and are not tested.

Functional Diagram



NOTE: This functional diagram reduces the circuitry down to its simplest equivalent components. Tie down unused inputs.

FIGURE 1. FUNCTIONAL DIAGRAM

TRUTH TABLE

THRESHOLD VOLTAGE	TRIGGER VOLTAGE	RESET	OUTPUT	DISCHARGE SWITCH
Don't Care	Don't Care	Low	Low	On
> ² / ₃ (V ₊)	> ¹ / ₃ (V ₊)	High	Low	On
< ² / ₃ (V ₊)	> ¹ / ₃ (V ₊)	High	Stable	Stable
Don't Care	< ¹ / ₃ (V ₊)	High	High	Off

NOTE: $\overline{\text{RESET}}$ will dominate all other inputs: $\overline{\text{TRIGGER}}$ will dominate over THRESHOLD.

Schematic Diagram

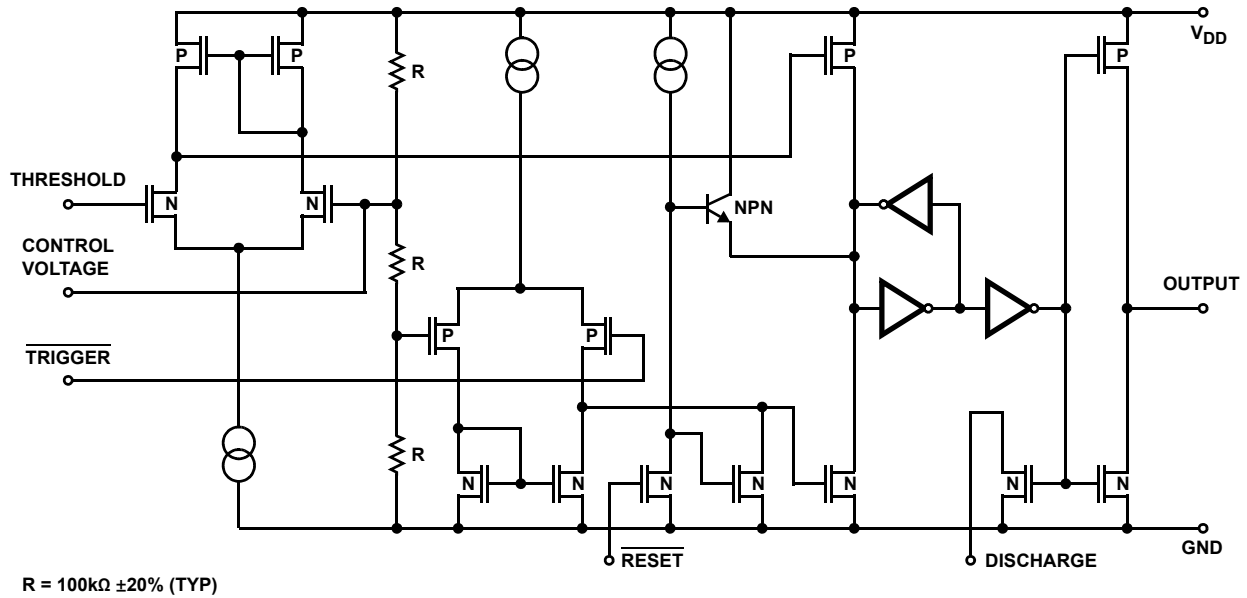


FIGURE 2. SCHEMATIC DIAGRAM

Application Information

General

The ICM7555 and ICM7556 devices are, in most instances, direct replacements for the SE/NE 555/556 devices. However, it is possible to effect economies in the external component count using the ICM7555 and ICM7556. Because the bipolar SE/NE 555/556 devices produce large crowbar currents in the output driver, it is necessary to decouple the power supply lines with a good capacitor close to the device. The ICM7555 and ICM7556 devices produce no such transients (see [Figure 3](#)).

The ICM7555 and ICM7556 produce supply current spikes of only 2mA to 3mA instead of 300mA to 400mA and supply decoupling is normally not necessary. Also, in most instances, the Control Voltage decoupling capacitors are not required since the input impedance of the CMOS comparators on chip are very high. Thus, for many applications, two capacitors can be saved using an ICM7555 and three capacitors with an ICM7556.

POWER SUPPLY CONSIDERATIONS

Although the supply current consumed by the ICM7555 and ICM7556 devices is very low, the total system supply current can be high unless the timing components are high impedance. Therefore, use high values for R and low values for C in [Figures 4, 5, and 6](#).

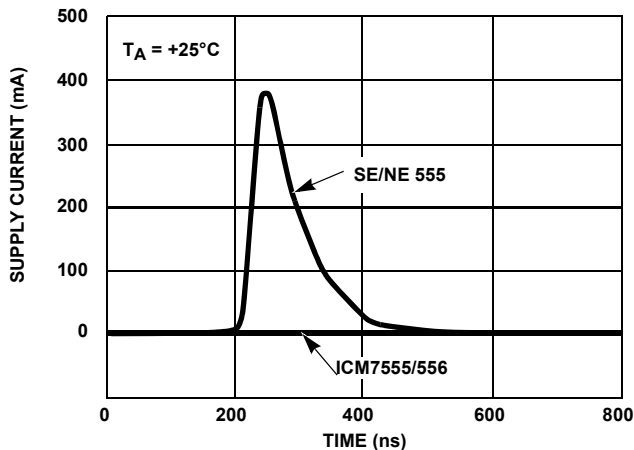


FIGURE 3. SUPPLY CURRENT TRANSIENT COMPARED WITH A STANDARD BIPOLAR 555 DURING AN OUTPUT TRANSITION

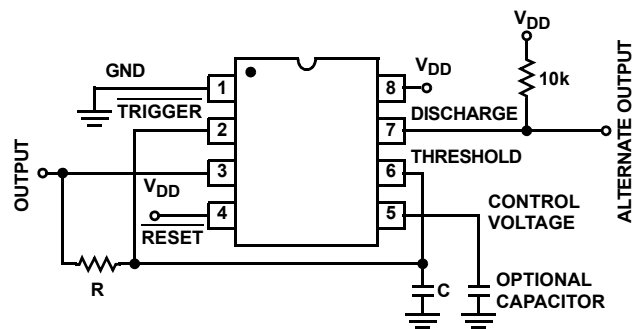


FIGURE 4. ASTABLE OPERATION

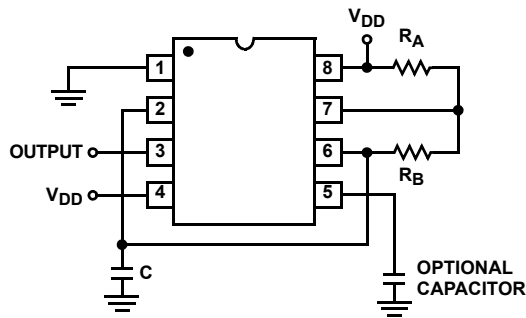


FIGURE 5. ALTERNATE ASTABLE CONFIGURATION

OUTPUT DRIVE CAPABILITY

The output driver consists of a CMOS inverter capable of driving most logic families including CMOS and TTL. As such, if driving CMOS, the output swing at all supply voltages will equal the supply voltage. At a supply voltage of 4.5V or more, the ICM7555 and ICM7556 will drive at least two standard TTL loads.

ASTABLE OPERATION

The circuit can be connected to trigger itself and free run as a multivibrator, see Figure 4. The output swings from rail-to-rail, and is a true 50% duty cycle square wave. Trip points and output swings are symmetrical. Less than a 1% frequency variation is observed over a voltage range of +5V to +15V.

$$f = \frac{1}{1.4 RC} \tag{EQ. 1}$$

The timer can also be connected as shown in Figure 5. In this circuit, the frequency is as shown by Equation 2:

$$f = 1.44 / (R_A + 2R_B)C \tag{EQ. 2}$$

The duty cycle is controlled by the values of RA and RB, by Equation 3:

$$D = (R_A + R_B) / (R_A + 2R_B) \tag{EQ. 3}$$

MONOSTABLE OPERATION

In this mode of operation, the timer functions as a one-shot (see Figure 6). Initially the external capacitor (C) is held discharged by a transistor inside the timer. Upon application of a negative Trigger pulse to pin 2, the internal flip-flop is set, which releases the short-circuit across the external capacitor and drives the Output high. The voltage across the capacitor now increases exponentially with a time constant $t = R_A C$. When the voltage across the capacitor equals $\frac{2}{3} V+$, the comparator resets the flip-flop, which in turn discharges the capacitor rapidly and also drives the OUTPUT to its low state. Trigger must return to a high state before the OUTPUT can return to a low state.

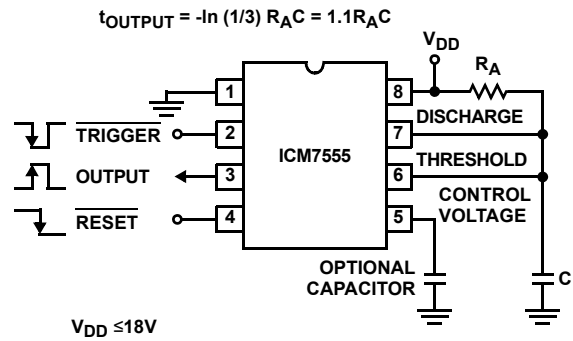


FIGURE 6. MONOSTABLE OPERATION

CONTROL VOLTAGE

The Control Voltage terminal permits the two trip voltages for the Threshold and Trigger internal comparators to be controlled. This provides the possibility of oscillation frequency modulation in the astable mode or even inhibition of oscillation, depending on the applied voltage. In the monostable mode, delay times can be changed by varying the applied voltage to the Control Voltage pin.

RESET

The Reset terminal is designed to have essentially the same trip voltage as the standard bipolar 555/556, i.e., 0.6V to 0.7V. At all supply voltages it represents an extremely high input impedance. The mode of operation of the Reset function is, however, much improved over the standard bipolar SE/NE 555/556 in that it controls only the internal flip-flop, which in turn controls simultaneously the state of the Output and Discharge pins. This avoids the multiple threshold problems sometimes encountered with slow falling edges in the bipolar devices.

Typical Performance Curves

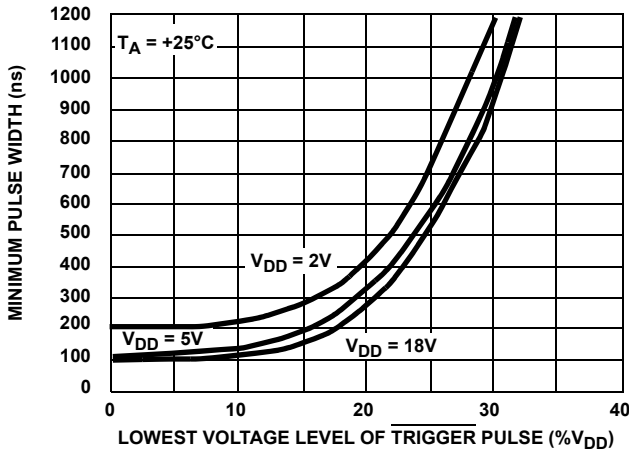


FIGURE 7. MINIMUM PULSE WIDTH REQUIRED FOR TRIGGERING

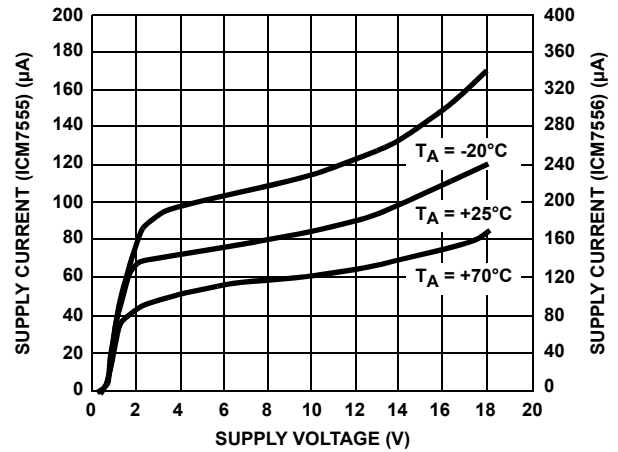


FIGURE 8. SUPPLY CURRENT vs SUPPLY VOLTAGE

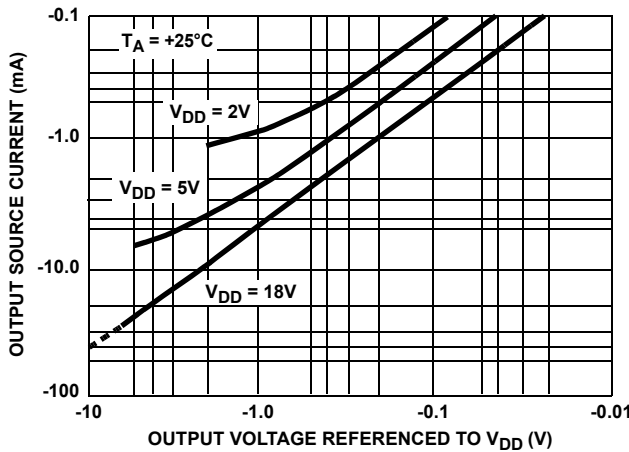


FIGURE 9. OUTPUT SOURCE CURRENT vs OUTPUT VOLTAGE

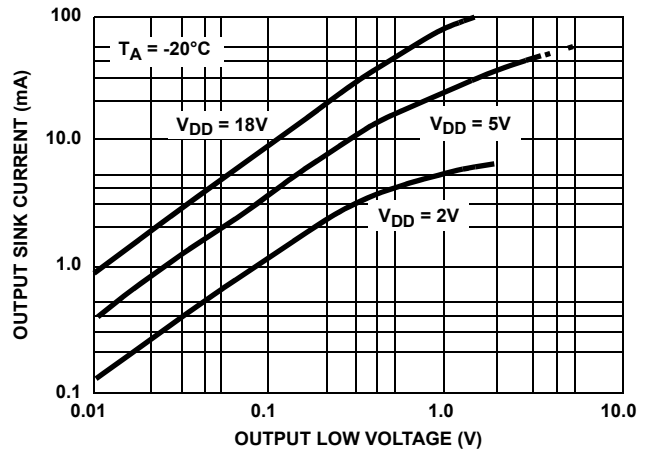


FIGURE 10. OUTPUT SINK CURRENT vs OUTPUT VOLTAGE

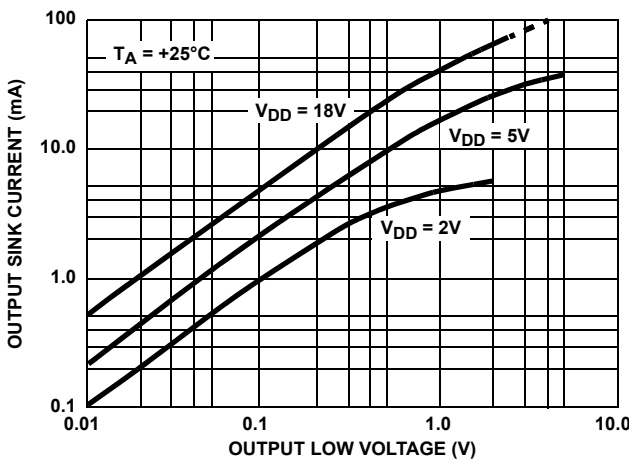


FIGURE 11. OUTPUT SINK CURRENT vs OUTPUT VOLTAGE

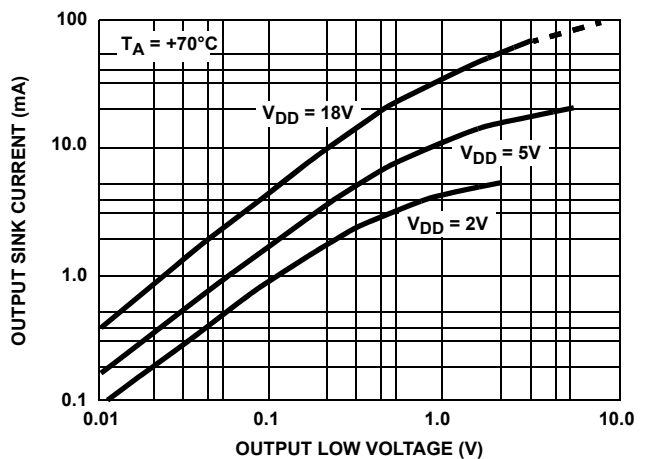


FIGURE 12. OUTPUT SINK CURRENT vs OUTPUT VOLTAGE

Typical Performance Curves (Continued)

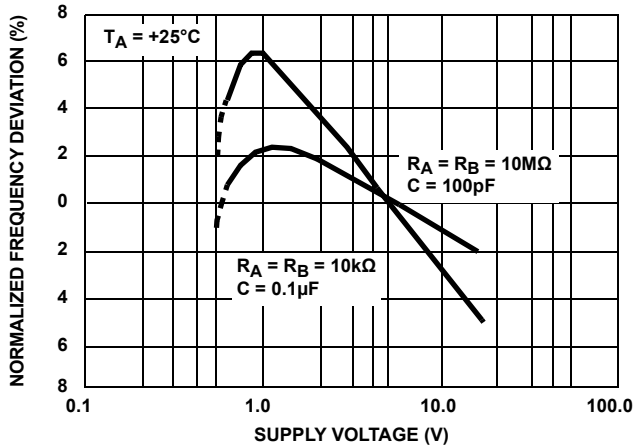


FIGURE 13. NORMALIZED FREQUENCY STABILITY IN THE ASTABLE MODE vs SUPPLY VOLTAGE

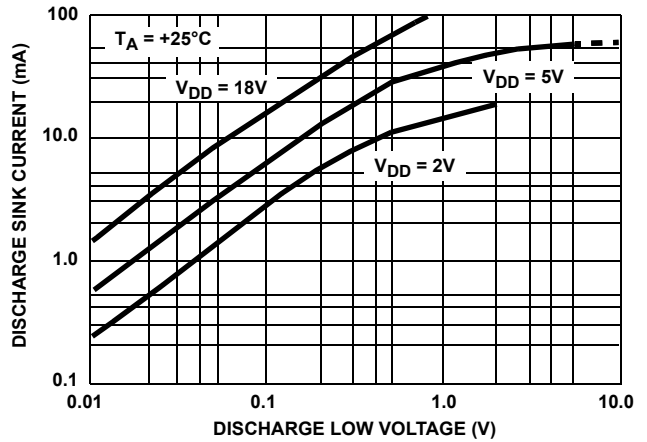


FIGURE 14. DISCHARGE OUTPUT CURRENT vs DISCHARGE OUTPUT VOLTAGE

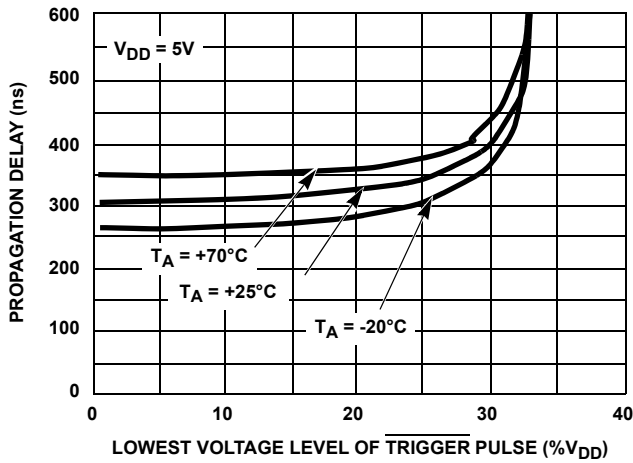


FIGURE 15. PROPAGATION DELAY vs VOLTAGE LEVEL OF TRIGGER PULSE

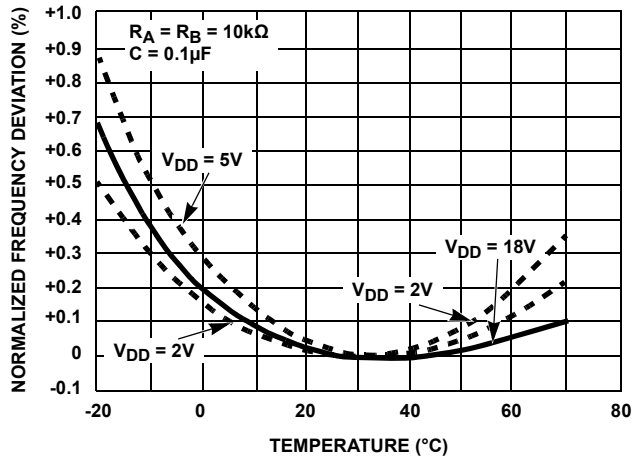


FIGURE 16. NORMALIZED FREQUENCY STABILITY IN THE ASTABLE MODE vs TEMPERATURE

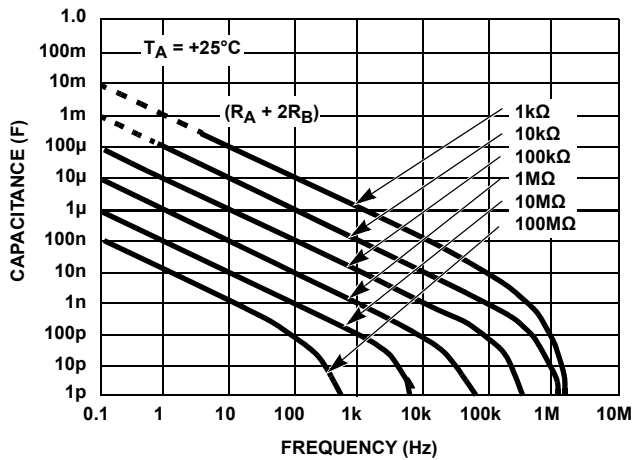


FIGURE 17. FREE RUNNING FREQUENCY vs R_A , R_B AND C

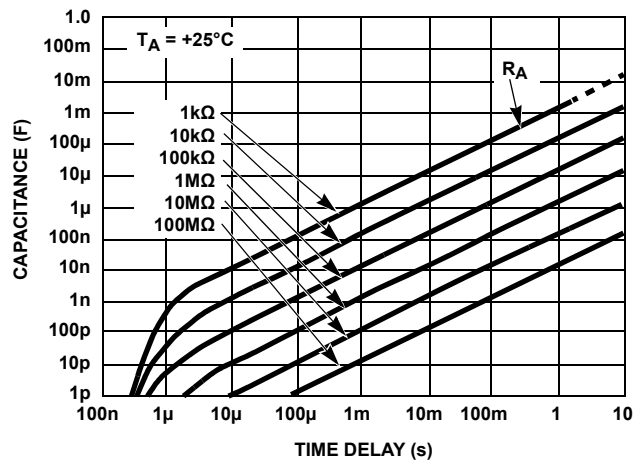


FIGURE 18. TIME DELAY IN THE MONOSTABLE MODE vs R_A AND C

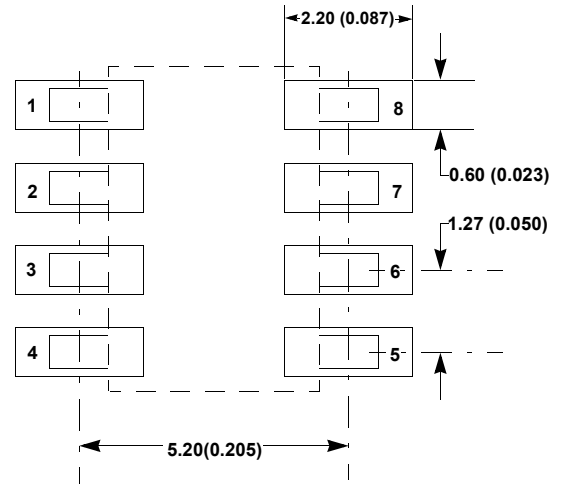
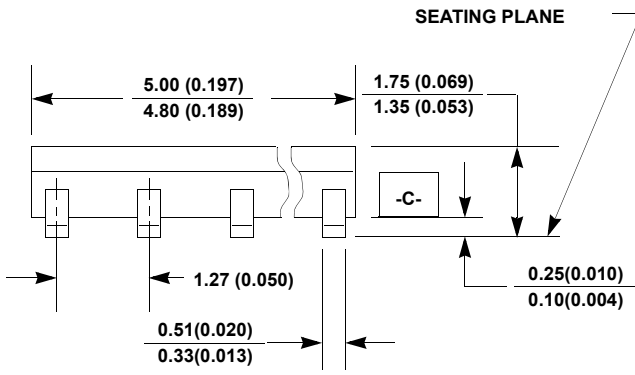
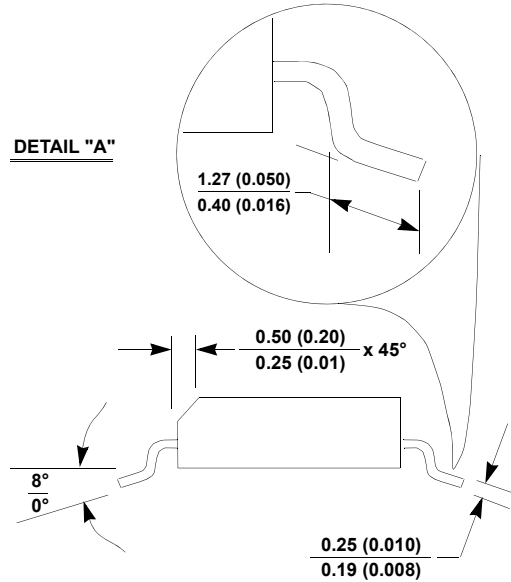
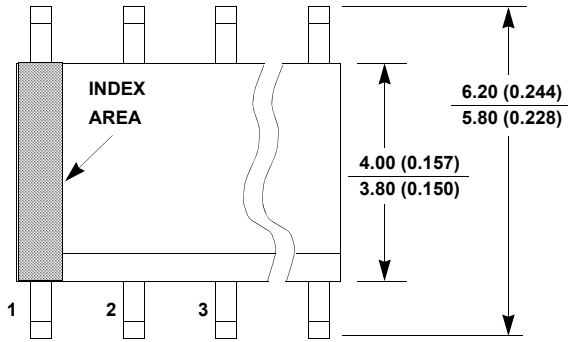
Revision History The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please go to the web to make sure that you have the latest revision.

DATE	REVISION	CHANGE
Mar 5, 2020	10.01	Added Related Literature section. Removed CERDIP part information. Added ESD information. Removed About Intersil Updated Disclaimer
Jun 28, 2016	10.00	Converted to new datasheet template. Updated 14 Ld PDIP "Pin Configuration" on page 1 by adding "1" or "2" to pins that have same name. Updated "Thermal Information" on page 3 by removing Maximum Lead Temperature and Adding T _{JC} values with corresponding note. Updated "Ordering Information" table on page 2 by removing obsoleted parts, adding Tape and Reel option column, adding MSL note and numbering notes accordingly. Updated POD M8.15 to most current version. POD changes are as follows: Changed in Typical Recommended Land Pattern the following: 2.41(0.095) to 2.20(0.087) 0.76 (0.030) to 0.60(0.023) 0.200 to 5.20(0.205) Updated to new POD format by removing table and moving dimensions onto drawing and adding land pattern

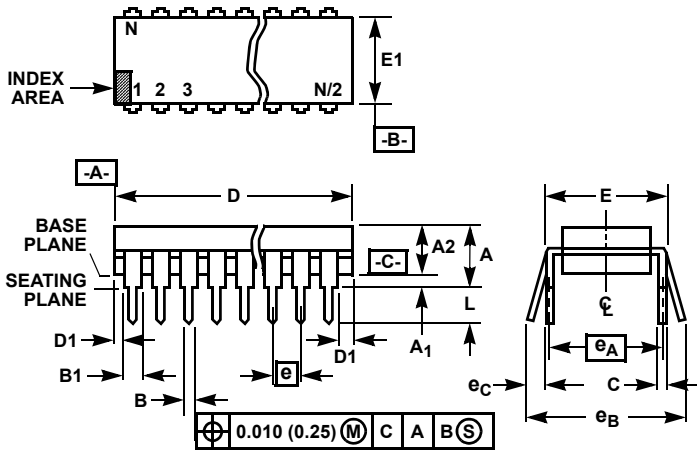
Package Outline Drawing

For the most recent package outline drawing, see [M8.15](#).

M8.15
 8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE
 Rev 4, 1/12



- NOTES:
1. Dimensioning and tolerancing per ANSI Y14.5M-1994.
 2. Package length does not include mold flash, protrusions or gate burrs. Mold flash, protrusion and gate burrs shall not exceed 0.15mm (0.006 inch) per side.
 3. Package width does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
 4. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
 5. Terminal numbers are shown for reference only.
 6. The lead width as measured 0.36mm (0.014 inch) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.024 inch).
 7. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.
 8. This outline conforms to JEDEC publication MS-012-AA ISSUE C.



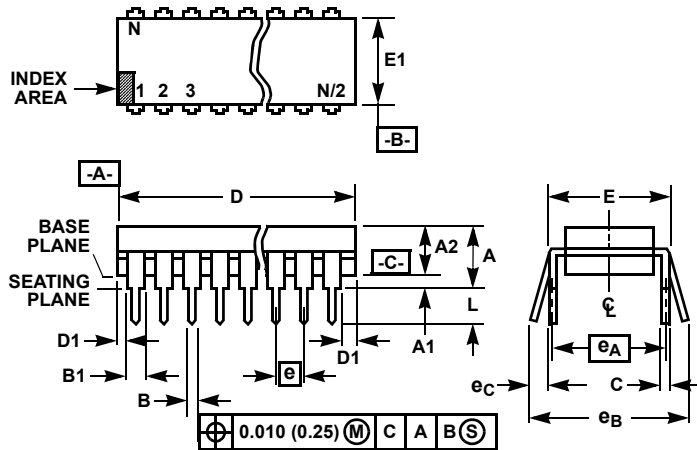
E8.3 (JEDEC MS-001-BA ISSUE D)
8 LEAD DUAL-IN-LINE PLASTIC PACKAGE (PDIP)

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.210	-	5.33	4
A1	0.015	-	0.39	-	4
A2	0.115	0.195	2.93	4.95	-
B	0.014	0.022	0.356	0.558	-
B1	0.045	0.070	1.15	1.77	8, 10
C	0.008	0.014	0.204	0.355	-
D	0.355	0.400	9.01	10.16	5
D1	0.005	-	0.13	-	5
E	0.300	0.325	7.62	8.25	6
E1	0.240	0.280	6.10	7.11	5
e	0.100 BSC		2.54 BSC		-
eA	0.300 BSC		7.62 BSC		6
eB	-	0.430	-	10.92	7
L	0.115	0.150	2.93	3.81	4
N	8		8		9

NOTES:

- Controlling Dimensions: INCH. In case of conflict between English and Metric dimensions, the inch dimensions control.
- Dimensioning and tolerancing per ANSI Y14.5M-1982.
- Symbols are defined in the "M0 Series Symbol List" in Section 2.2 of Publication No. 95.
- Dimensions A, A1 and L are measured with the package seated in JEDEC seating plane gauge GS-3.
- D, D1, and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch (0.25mm).
- E and eA are measured with the leads constrained to be perpendicular to datum -C-.
- eB and eC are measured at the lead tips with the leads unconstrained. eC must be zero or greater.
- B1 maximum dimensions do not include dambar protrusions. Dambar protrusions shall not exceed 0.010 inch (0.25mm).
- N is the maximum number of terminal positions.
- Corner leads (1, N, N/2 and N/2 + 1) for E8.3, E16.3, E18.3, E28.3, E42.6 will have a B1 dimension of 0.030 - 0.045 inch (0.76 - 1.14mm).

Rev. 0 12/93



NOTES:

1. Controlling Dimensions: INCH. In case of conflict between English and Metric dimensions, the inch dimensions control.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Symbols are defined in the "MO Series Symbol List" in Section 2.2 of Publication No. 95.
4. Dimensions A, A1 and L are measured with the package seated in JEDEC seating plane gauge GS-3.
5. D, D1, and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch (0.25mm).
6. E and e_A are measured with the leads constrained to be perpendicular to datum -C-.
7. e_B and e_C are measured at the lead tips with the leads unconstrained. e_C must be zero or greater.
8. B1 maximum dimensions do not include dambar protrusions. Dambar protrusions shall not exceed 0.010 inch (0.25mm).
9. N is the maximum number of terminal positions.
10. Corner leads (1, N, N/2 and N/2 + 1) for E8.3, E16.3, E18.3, E28.3, E42.6 will have a B1 dimension of 0.030 - 0.045 inch (0.76 - 1.14mm).

E14.3 (JEDEC MS-001-AA ISSUE D)
14 LEAD DUAL-IN-LINE PLASTIC PACKAGE (PDIP)

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.210	-	5.33	4
A1	0.015	-	0.39	-	4
A2	0.115	0.195	2.93	4.95	-
B	0.014	0.022	0.356	0.558	-
B1	0.045	0.070	1.15	1.77	8
C	0.008	0.014	0.204	0.355	-
D	0.735	0.775	18.66	19.68	5
D1	0.005	-	0.13	-	5
E	0.300	0.325	7.62	8.25	6
E1	0.240	0.280	6.10	7.11	5
e	0.100 BSC		2.54 BSC		-
e_A	0.300 BSC		7.62 BSC		6
e_B	-	0.430	-	10.92	7
L	0.115	0.150	2.93	3.81	4
N	14		14		9

Rev. 0 12/93

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
 2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
 3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
 4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
 5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
 - "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
 - "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
 6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
 7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
 8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
 9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
 10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
 11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
 12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.
- (Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.
- (Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.