

## Asynchronous parallel in or synchronous serial in/serial out 8-stage static shift register

Datasheet – production data

### Features

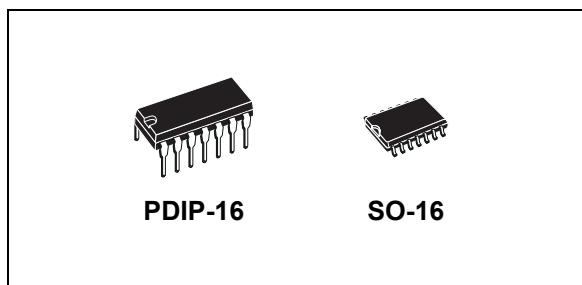
- Medium speed operation: 12 MHz (typ.) clock rate at  $V_{DD} - V_{SS} = 10\text{ V}$
- Fully static operation
- 8 master-slave flip-flops plus output buffering and control gating
- Quiescent current specified up to 20 V
- 5 V, 10 V, and 15 V parametric ratings
- Input leakage current  $I_l = 100\text{ nA}$  (max.) at  $V_{DD} = 18\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$
- 100 % tested for quiescent current

### Applications

- Automotive
- Industrial
- Computer
- Consumer

### Description

The HCF4021 is a monolithic integrated circuit fabricated in metal oxide semiconductor technology available in PDIP-16 and SO-16 packages.



This device is an 8-stage parallel or serial input/serial output register having common clock and parallel/serial control inputs, a single serial data input, and individual parallel "jam" inputs to each register stage. Each register stage is a D-type, master-slave flip-flop in addition to an output from stage 8. "Q" outputs are also available from stages 6 and 7. Serial entry is synchronous with the clock but parallel entry is asynchronous.

In this device, entry is controlled by the parallel/serial control input. When the parallel/serial control input is low, data are serially shifted into the 8-stage register synchronously with the positive transition of the clock line. When the parallel/serial control input is high, data are jammed into the 8-stage register via the parallel input lines and synchronous with the positive transition of the clock line. The clock input of the internal stage is "forced" when asynchronous parallel entry is made. Register expansion using multiple package is permitted.

**Table 1. Device summary table**

Order code	Temperature range	Package	Packing	Marking
HCF4021M013TR	-55 ° C to +125 ° C	SO-16	Tape & reel	HCF4021
HCF4021YM013TR (1)	-40 ° C to +125 ° C	SO-16 (automotive grade) <sup>(1)</sup>		HCF4021Y
HCF4021BEY	-55 ° C to +125 ° C	PDIP-16	Tube	HCF4021BE

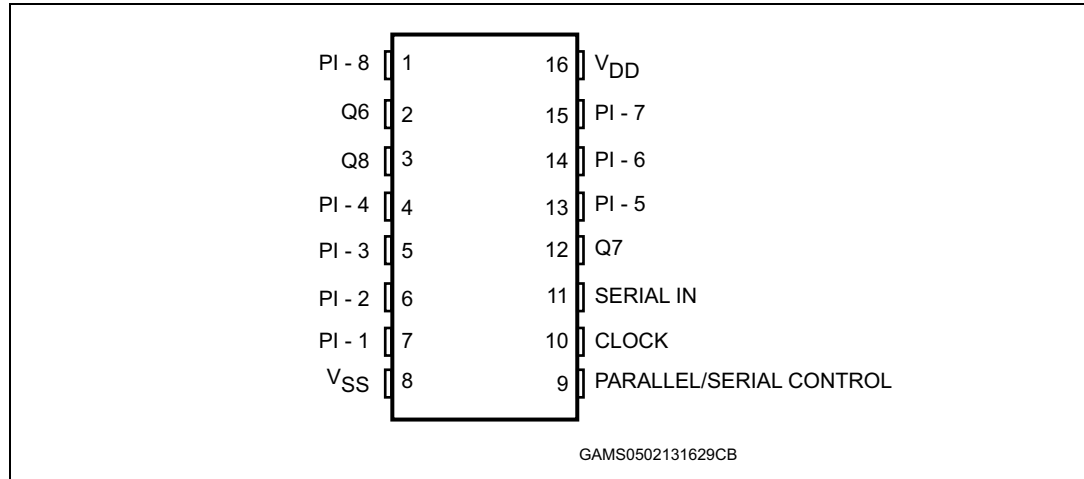
1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q002 or equivalent are ongoing.

# Contents

<b>1</b>	<b>Pin information</b> .....	<b>3</b>
<b>2</b>	<b>Functional description</b> .....	<b>4</b>
<b>3</b>	<b>Electrical characteristics</b> .....	<b>5</b>
<b>4</b>	<b>Package information</b> .....	<b>10</b>
	4.1 PDIP-16 (0.25) package information .....	10
	4.2 SO-16 package information .....	11
<b>5</b>	<b>Ordering information</b> .....	<b>12</b>
<b>6</b>	<b>Revision history</b> .....	<b>12</b>

# 1 Pin information

**Figure 1. Pin connections (top view)**



**Table 2. Pin description**

Pin no	Symbol	Name and function
7, 6, 5, 4, 13, 14, 15, 1	PI-1 to PI-8	Parallel input
11	SERIAL IN	Serial input
9	PARALLEL/SERIAL CONTROL	Parallel/serial input control
10	CLOCK	Clock input
2, 3, 12	Q6, Q7, Q8	Buffered outputs
8	V <sub>SS</sub>	Negative supply voltage
16	V <sub>DD</sub>	Positive supply voltage

## 2 Functional description

Figure 2. Logic diagram

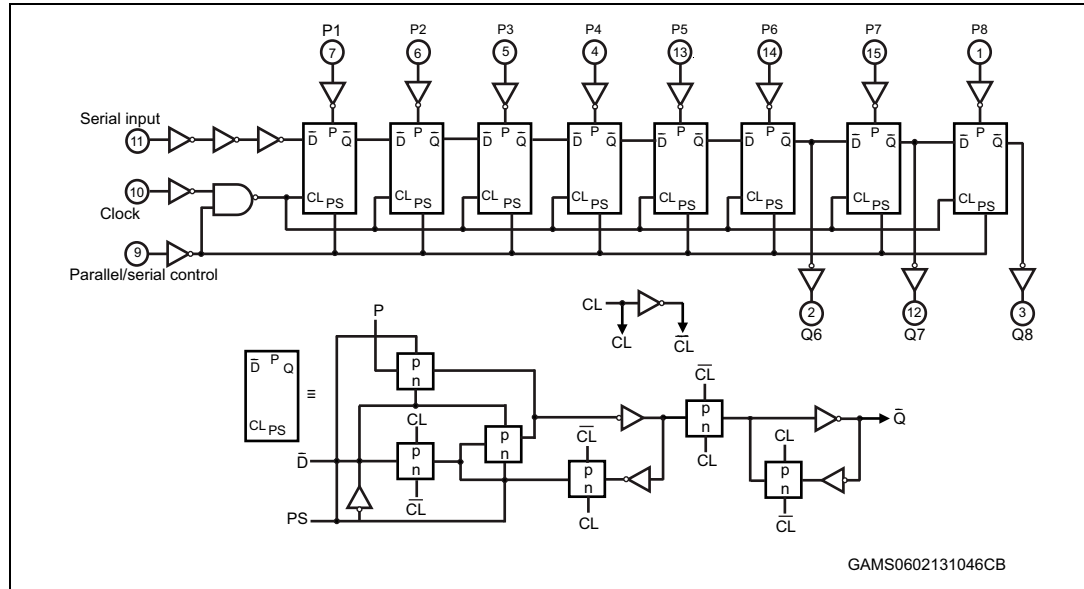
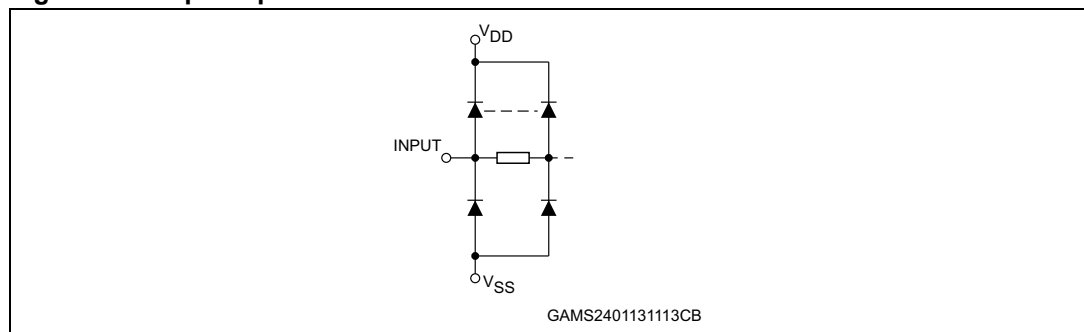


Table 3. Truth table

Clock	Serial input	Parallel/serial control	PI-1	PI-n	Q <sub>1</sub> (internal)	Q <sub>n</sub>
X <sup>(1)</sup>	X <sup>(1)</sup>	1	0	0	0	0
X <sup>(1)</sup>	X <sup>(1)</sup>	1	0	1	0	1
X <sup>(1)</sup>	X <sup>(1)</sup>	1	1	0	1	0
X <sup>(1)</sup>	X <sup>(1)</sup>	1	1	1	1	1
⌋	0	0	X <sup>(1)</sup>	X <sup>(1)</sup>	0	Q <sub>n-1</sub>
⌋	1	0	X <sup>(1)</sup>	X <sup>(1)</sup>	1	Q <sub>n-1</sub>
⌋	X <sup>(1)</sup>	X <sup>(1)</sup>	X <sup>(1)</sup>	X <sup>(1)</sup>	Q <sub>1</sub>	Q <sub>n</sub>

1. Don't care

Figure 3. Input equivalent circuit



### 3 Electrical characteristics

Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. All voltage values are referred to  $V_{SS}$  pin voltage.

**Table 4. Absolute maximum ratings (AMR)**

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply voltage	-0.5 to +22	V
$V_I$	DC input voltage	-0.5 to $V_{DD} + 0.5$	
$I_I$	DC input current	$\pm 10$	mA
$P_D$	Power dissipation per package	200	mW
	Power dissipation per output transistor	100	
$T_{op}$	Operating temperature	-55 to +125	°C
$T_{stg}$	Storage temperature	-65 to +150	

**Table 5. Recommended operating conditions**

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply voltage	3 to 20	V
$V_I$	Input voltage	0 to $V_{DD}$	
$T_{op}$	Operating temperature	-55 to 125	°C

Table 6. DC specifications<sup>(1)</sup>

Sym.	Parameter	Test condition				Value						Unit	
		V <sub>I</sub> (V)	V <sub>O</sub> (V)	I <sub>O</sub>   (μA)	V <sub>DD</sub> (V)	T <sub>A</sub> = 25 °C			-40 to 85 °C		-55 to 125°C		
						Min.	Typ.	Max.	Min.	Max.	Min.		Max.
I <sub>L</sub>	Quiescent current	0/5			5			5		150		150	μA
		0/10			10		0.04	10		300		300	
		0/15			15			20		600		600	
		0/20			20		0.08	100		3000		3000	
V <sub>OH</sub>	High level output voltage	0/5		<1	5	4.95			4.95		4.95		V
		0/10			10	9.95			9.95		9.95		
		0/15			15	14.95			14.95		14.95		
V <sub>OL</sub>	Low level output voltage	5/0		<1	5		0.05			0.05		0.05	
		10/0			10								
		15/0			15								
V <sub>IH</sub>	High level input voltage		0.5/4.5	<1	5	3.5			3.5		3.5		
			1/9		10	7			7		7		
			1.5/13.5		15	11			11		11		
V <sub>IL</sub>	Low level input voltage		4.5/0.5	<1	5			1.5		1.5		1.5	
			9/1		10			3		3		3	
			13.5/1.5		15			4		4		4	
I <sub>OH</sub>	Output drive current	0/5	2.5	<1	5	-1.36	-3.2		-1.1		-1.1		
			4.6			-0.44	-1		-0.36		-0.36		
		0/10	9.5		10	-1.1	-2.6		-0.9		-0.9		
		0/15	13.5		15	-3.0	-6.8		-2.4		-2.4		
I <sub>OL</sub>	Output sink current	0/5	0.4	<1	5	0.44	1		0.36		0.36	mA	
		0/10	0.5		10	1.1	2.6		0.9		0.9		
		0/15	1.5		15	3.0	6.8		2.4		2.4		
I <sub>I</sub>	Input leakage current	0/18	Any input	18		±10 <sup>-5</sup>	±0.1		±1		±1	μA	
C <sub>I</sub>	Input capacitance		Any input			5	7.5					pF	

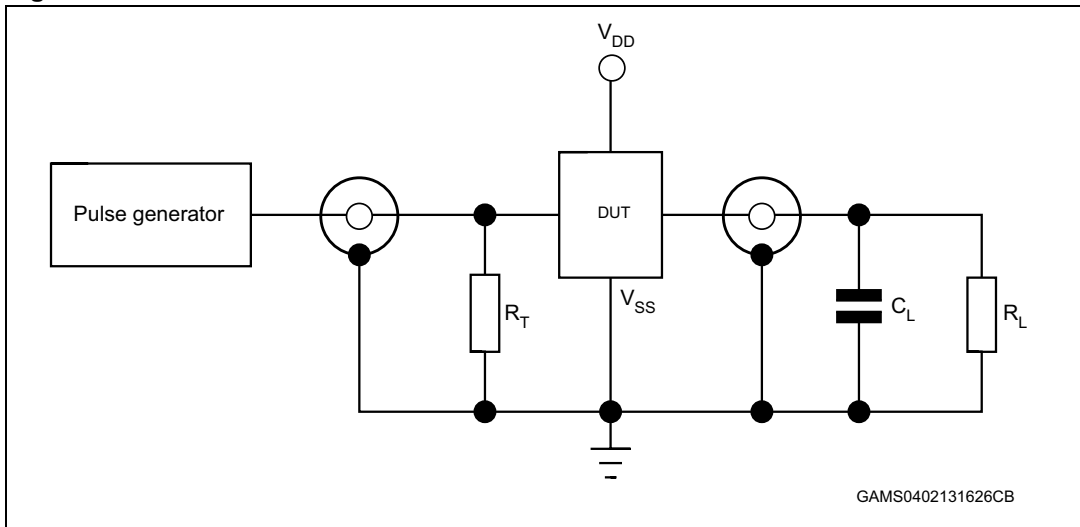
1. The noise margin for both level "1" and "0" is: 1 V min. with V<sub>DD</sub> = 5 V, 2 V min. with V<sub>DD</sub> = 10 V, and 2.5 V min. with V<sub>DD</sub> = 15 V.

**Table 7. Dynamic electrical characteristics ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$ ,  $t_r = t_f = 20\text{ ns}$ )**

Symbol	Parameter	Test condition	Value <sup>(1)</sup>			Unit
		$V_{DD}$ (V)	Min.	Typ.	Max.	
$t_{PLH}$ , $t_{PHL}$	Propagation delay time	5		160	320	ns
		10		80	160	
		15		60	120	
$t_{THL}$ , $t_{TLH}$	Transition time	5		100	200	ns
		10		50	100	
		15		40	80	
$f_{CL}^{(2)}$	Maximum clock input frequency	5	3	6		MHz
		10	6	12		
		15	8.5	17		
$t_w$	Clock pulse width	5	180	90		ns
		10	80	40		
		15	50	25		
$t_r$ , $t_f$	Clock input rise or fall time	5			15	$\mu\text{s}$
		10				
		15				
$t_s$	Minimum setup time, serial input $t_H \geq 200\text{ ns}$ (ref to CL)	5	120	60		ns
		10	80	40		
		15	60	30		
	Minimum setup time, parallel inputs $t_H \leq 200\text{ ns}$ (ref to P/S)	5	50	25		
		10	30	15		
		15	20	10		
$t_h$	Hold time, serial in, parallel in, parallel/serial control	5	0			
		10				
		15				
$t_{WH}$	P/S pulse width	5	160	80		
		10	80	40		
		15	50	25		
$t_{rem}$	P/S removal time ref to CL)	5	280	140		
		10	140	70		
		15	100	50		

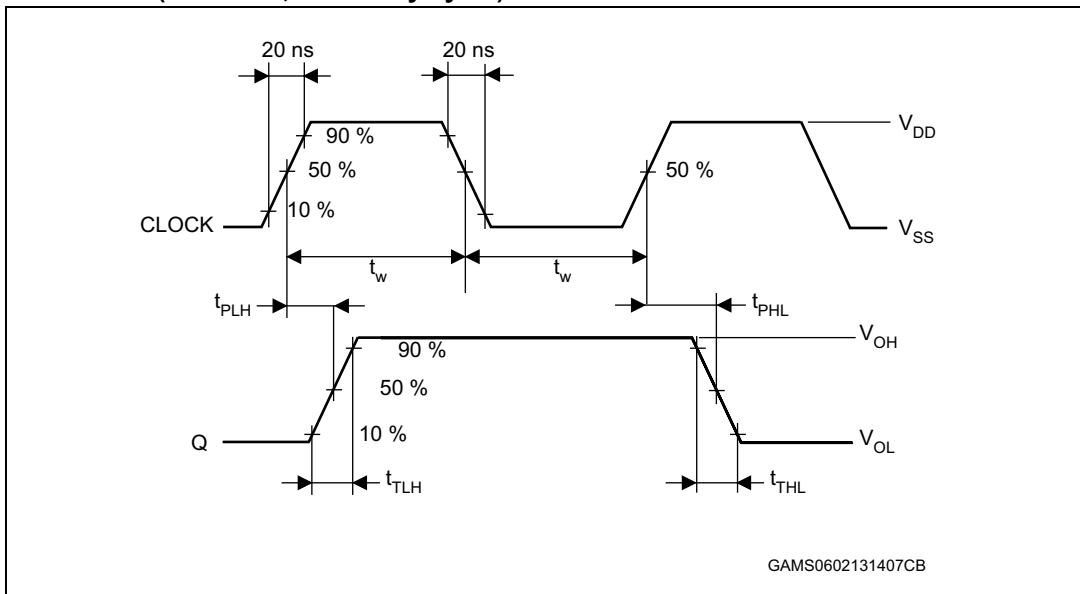
1. The typical temperature coefficient for all  $V_{DD}$  values is 0.3 %/°C.
2. If more than one unit is cascaded,  $t_{rCL}$  should be made less than or equal to the sum of the transition time and the fixed propagation delay of the output of the driving stage of the estimated capacitive load.

Figure 4. Test circuit



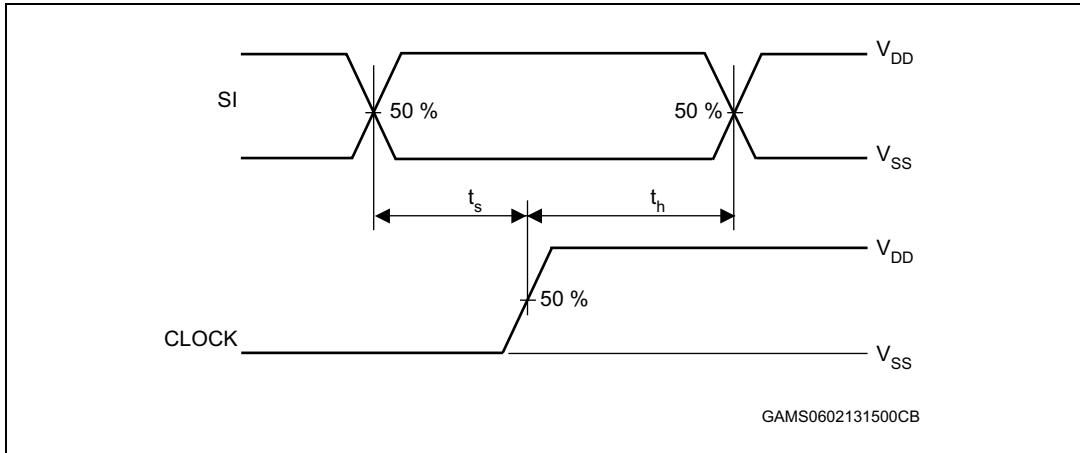
- Legend:  $C_L = 50 \text{ pF}$  or equivalent (includes jig and probe capacitance),  $R_L = 200 \text{ K}\Omega$ ,  $R_T = Z_{OUT}$  of pulse generator (typically  $50 \Omega$ )

Figure 5. Waveform 1; propagation delay times, clock pulse width ( $f = 1 \text{ MHz}$ ; 50 % duty cycle)

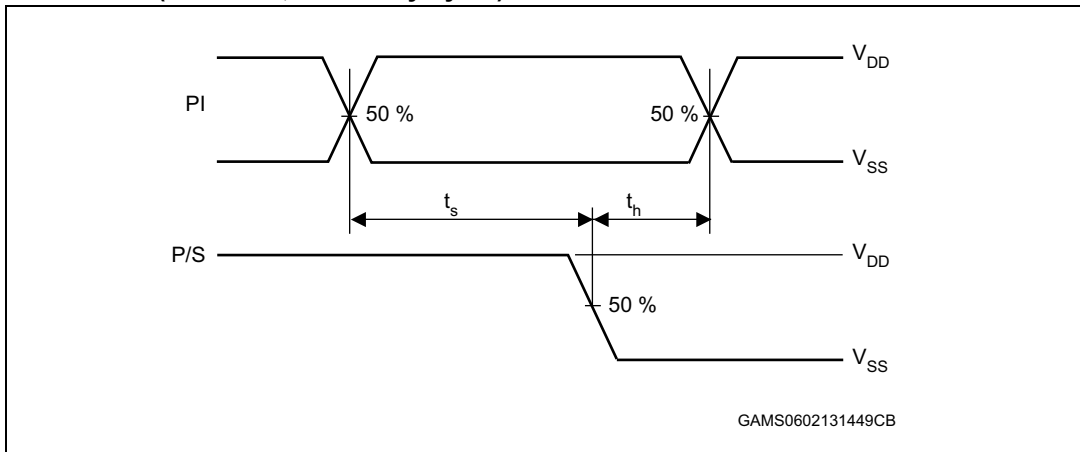




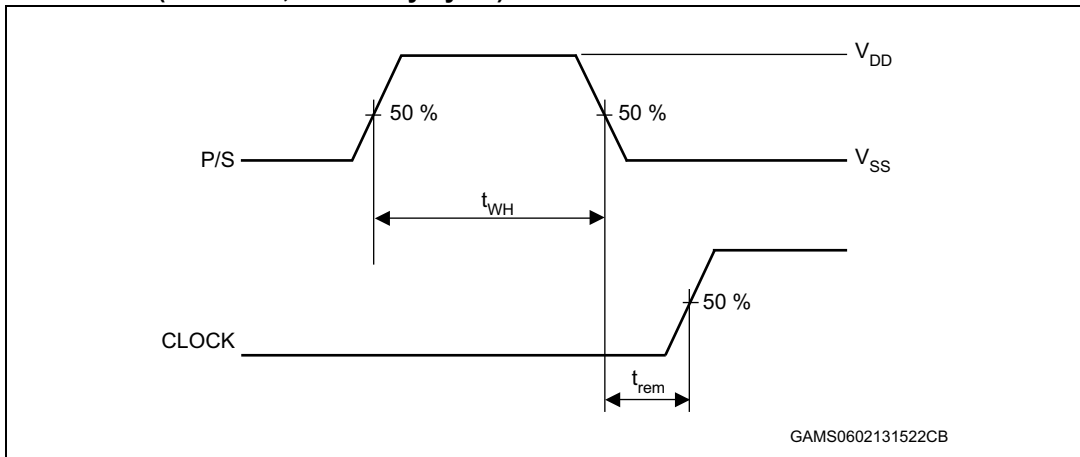
**Figure 6. Waveform 2: Setup and hold times (SI to CLOCK)**  
 (f = 1 MHz; 50 % duty cycle)



**Figure 7. Waveform 3: Setup and hold time (PI to P/S)**  
 (f = 1 MHz; 50 % duty cycle)



**Figure 8. Waveform 4: Pulse width and removal time (P/S to clock)**  
 (f = 1 MHz; 50 % duty cycle)



## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 4.1 PDIP-16 (0.25) package information

Figure 9. PDIP-16 (0.25) package mechanical drawing

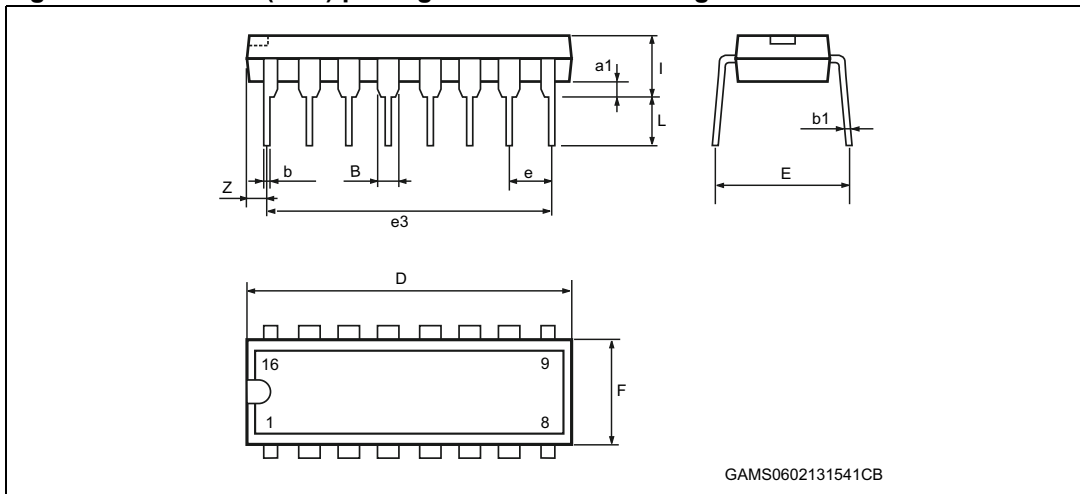


Table 8. PDIP-16 (0.25) package mechanical data

Ref	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
l			5.1			0.201
L		3.3			0.130	
Z	1.27		1.27	0.050		0.050

## 4.2 SO-16 package information

Figure 10. SO-16 package mechanical drawing

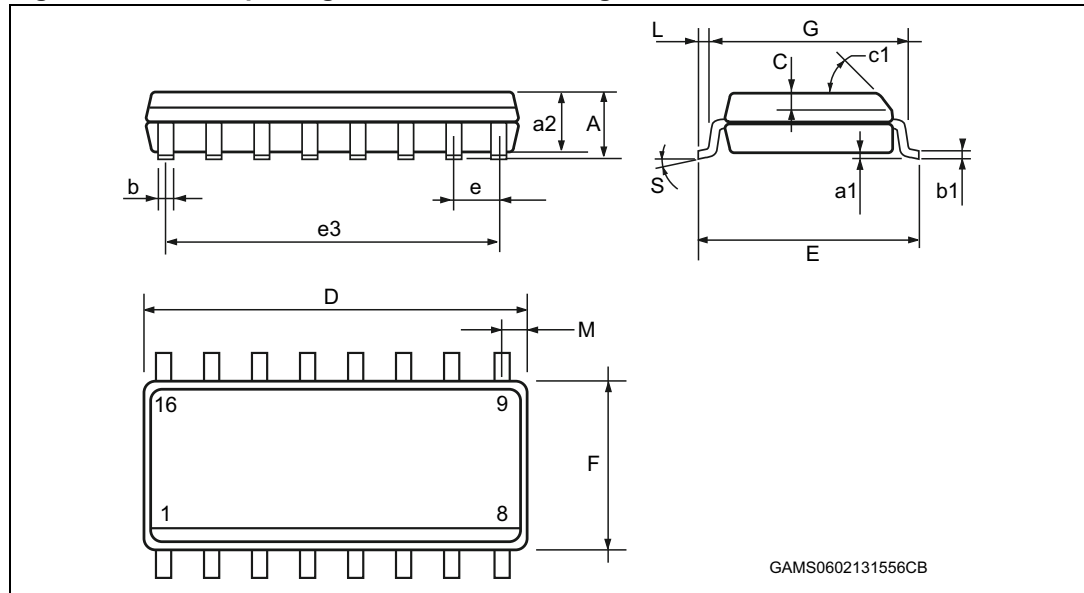


Table 9. SO-16 package mechanical data

Ref	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1		45 °			45 °	
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S			8 °			8 °

## 5 Ordering information

**Table 10. Order codes**

Order code	Temperature range	Package	Packing	Marking
HCF4021M013TR	-55 ° C to +125 ° C	SO-16	Tape & reel	HCF4021
HCF4021YM013TR (1)	-40 ° C to +125 ° C	SO16 (automotive grade) <sup>(1)</sup>		HCF4021Y
HCF4021BEY	-55 ° C to +125 ° C	PDIP-16	Tube	HCF4021BE

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q002 or equivalent are ongoing.

## 6 Revision history

**Table 11. Document revision history**

Date	Revision	Changes
Sep-2001	1	Initial release.
18-Feb-2013	2	Document template and layout updated Removed "B" from part number Updated package names (PDIP-16 and SO-16 instead of DIP-16 and SOP-16). Added <a href="#">Applications</a> Added <a href="#">Device summary table</a> Updated symbol names in <a href="#">Table 7</a> Added <a href="#">Section 5: Ordering information</a>

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY TWO AUTHORIZED ST REPRESENTATIVES, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2013 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)

