

# P2040C

## LCD Panel EMI Reduction IC

### Description

The P2040C is a selectable spread spectrum frequency modulator designed specifically for digital flat panel applications. The P2040C reduces electromagnetic interference (EMI) at the clock source which provides system wide reduction of EMI of all clock dependent signals. The P2040C allows significant system cost savings by reducing the number of circuit board layers and shielding that are traditionally required to pass EMI regulations.

The P2040C uses the most efficient and optimized modulation profile approved by the FCC and is implemented in a proprietary all-digital method. The P2040C modulates the output of a single PLL in order to “spread” the bandwidth of a synthesized clock and, more importantly, decreases the peak amplitudes of its harmonics. This results in a significantly lower system EMI compared to the typical narrow band signal produced by oscillators and most frequency generators. Lowering EMI by increasing a signal’s bandwidth is called ‘spread spectrum clock generation.’

### Applications

The P2040C is targeted towards digital flat panel applications for Notebook PCs, Palm-size PCs, Office Automation Equipments, and LCD Monitors.

### Features

- FCC Approved Method of EMI Attenuation
- Provides up to 15 dB of EMI Suppression
- Generates a Low EMI Spread Spectrum Clock of the Input Frequency
- 50 MHz to 173 MHz Input Frequency Range
- Optimized for 54 MHz, 65 MHz, 81 MHz, 140 MHz, and 162 MHz Pixel Clock Frequencies
- Internal Loop Filter Minimizes External Components and Board Space
- 8 Selectable Spread Ranges, up to  $\pm 2.2\%$
- SSON# Control Pin for Spread Spectrum Enable and Disable Options
- 2 Selectable Modulation Rates
- Low Cycle-to-Cycle Jitter
- 3.3 V Operating Voltage
- Ultra Low Power CMOS Design
- Supports Most Mobile Graphic Accelerator and LCD Timing Controller Specifications
- Available in 8-pin SOIC and TSSOP Packages
- These are Pb-Free Devices



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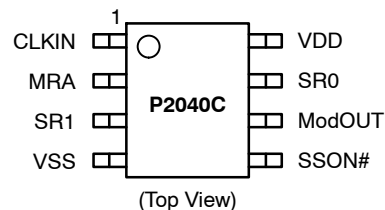


SOIC-8  
S SUFFIX  
CASE 751BD



TSSOP-8  
T SUFFIX  
CASE 948AL

### PIN CONFIGURATION



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

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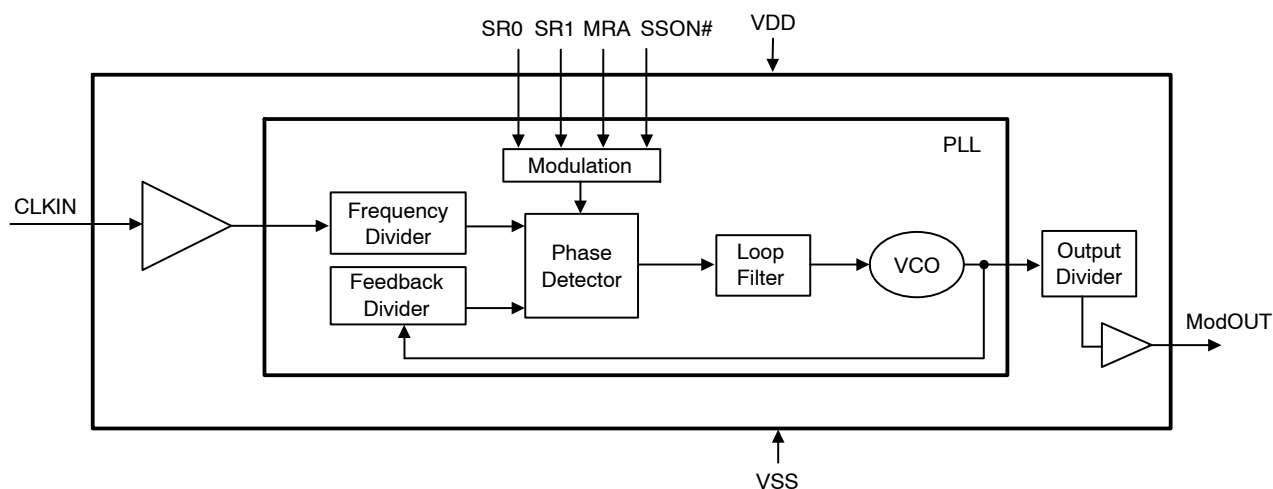


Figure 1. Block Diagram

Table 1. ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Rating	Unit
VDD, V <sub>IN</sub>	Voltage on any pin with respect to Ground	-0.5 to +4.6	V
T <sub>STG</sub>	Storage temperature	-65 to +125	°C
T <sub>A</sub>	Operating temperature	-40 to +125	°C
T <sub>s</sub>	Max. Soldering Temperature (10 sec)	260	°C
θ <sub>JA</sub>	Thermal Resistance from Junction to Ambient (No Air Flow)	For SOIC Package	156.5
		For TSSOP Package	124
T <sub>J</sub>	Junction Temperature	150	°C
T <sub>DV</sub>	Static Discharge Voltage (As per JEDEC STD22- A114-B)	2	KV

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Table 2. PIN DESCRIPTION

Pin#	Pin Name	Type	Description
1	CLKIN	I	External reference frequency input. Connect to externally generated reference signal.
2	MRA	I	Digital logic input used to select modulation rate. This pin has an internal pull-up resistor.
3	SR1	I	Digital logic input used to select Spreading Range. This pin has an internal pull-up resistor.
4	VSS	P	Ground to entire chip. Connect to system ground.
5	SSON#	I	Digital logic input used to enable Spread Spectrum function (Active LOW). Spread Spectrum function enabled when LOW, disabled when HIGH. This pin has an internal pull-low resistor.
6	ModOUT	O	Spread spectrum Clock Output.
7	SR0	I	Digital logic input used to select Spreading Range. This pin has an internal pull-up resistor.
8	VDD	P	Power supply for the entire chip.

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**Table 3. MODULATION SELECTION (Commercial)**

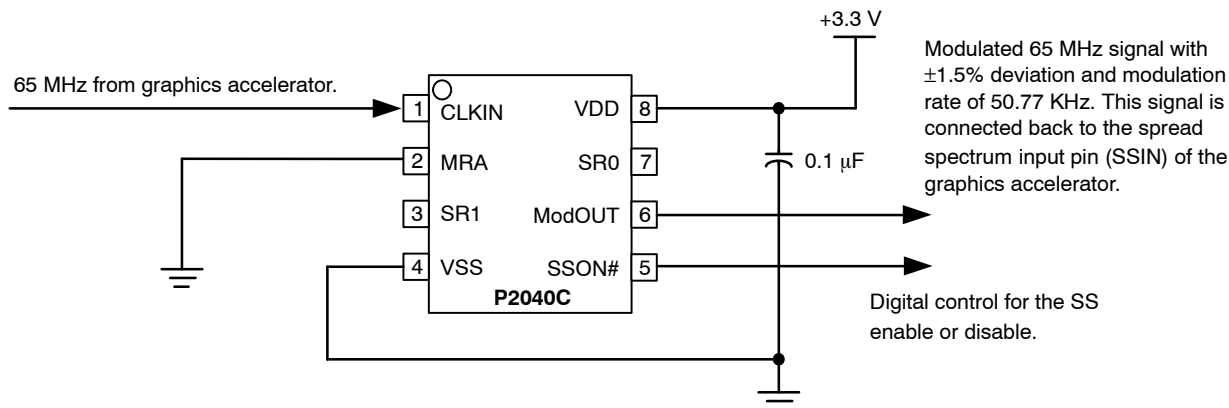
MRA	SR1	SR0	Spreading Range					Modulation Rate
			54 MHz	65 MHz	81 MHz	140 MHz	162 MHz	
0	0	0	±1.4%	±1.2%	±1.0%	±0.6%	±0.4%	(Fin/80) * 62.49 KHz
0	0	1	±2.0%	±1.9%	±1.6%	±1.0%	±0.8%	(Fin/80) * 62.49 KHz
0	1	0	±1.1%	±0.9%	±0.5%	±0.3%	±0.3%	(Fin/80) * 62.49 KHz
0	1	1	±1.8%	±1.5%	±1.0%	±0.54%	±0.4%	(Fin/80) * 62.49 KHz
1	0	0	±1.3%	±1.3%	±1.3%	±1.25%	±1.1%	(Fin/80) * 20.83 KHz
1	0	1	±2.2%	±2.1%	±2.1%	±2.0%	±1.8%	(Fin/80) * 20.83 KHz
1	1	0	±1.4%	±1.3%	±1.4%	±1.2%	±0.9%	(Fin/80) * 20.83 KHz
1	1	1	±2.1%	±2.1%	±2.1%	±1.9%	±1.4%	(Fin/80) * 20.83 KHz

### Spread Spectrum Selection

Table 3 illustrates the possible spread spectrum options. The optimal setting should minimize system EMI to the fullest without affecting system performance. The spreading is described as a percentage deviation of the center frequency (Note: The center frequency is the frequency of the external reference input on CLKIN, Pin 1).

### Example:

P2040C is designed for high resolution flat panel applications and is able to support panel frequencies from 50 MHz to 173 MHz. For a 65 MHz pixel clock frequency, a spreading selection of MRA = 0, SR1 = 1 and SR0 = 1 provides a percentage deviation of ±1.50% (see Table 3). This result in frequency on ModOUT being swept from 64.03 MHz to 65.98 MHz at a modulation rate of 50.77 KHz (see Table 3). This particular example (see figure below) given here is a common EMI reduction method for notebook LCD panel and has already been implemented by most of the leading OEM and mobile graphic accelerator manufacturers.



**Figure 2. Application Schematic for Mobile LCD Graphics Controllers**

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**Table 4. DC ELECTRICAL CHARACTERISTICS**

(Test condition: All parameters are measured at room temperature (+25°C) unless otherwise stated.)

Symbol	Parameter	Min	Typ	Max	Unit
$V_{IL}$	Input low voltage	VSS-0.3	-	0.8	V
$V_{IH}$	Input high voltage	2.0	-	VDD+0.3	V
$I_{IL}$	Input low current (pull-up resistor on inputs SR0, SR1 and MRA)	-	-	-40	$\mu$ A
$I_{IH}$	Input high current (pull-down resistor on input SSON#)	-	-	40	$\mu$ A
$V_{OL}$	Output low voltage (VDD = 3.3 V, $I_{OL}$ = 20 mA)	-	-	0.4	V
$V_{OH}$	Output high voltage (VDD = 3.3 V, $I_{OL}$ = 20 mA)	2.5	-	-	V
$I_{DD}$	Static supply current standby mode	-	0.7	-	mA
$I_{CC}$	Dynamic supply current (3.3 V and 10 pF loading)	9	16	22	mA
VDD	Operating Voltage	3.0	3.3	3.6	V
$t_{ON}$	Power-up time (first locked cycle after power up)	-	0.18	-	mS
$Z_{OUT}$	Clock output impedance	-	50	-	$\Omega$

**Table 5. AC ELECTRICAL CHARACTERISTICS**

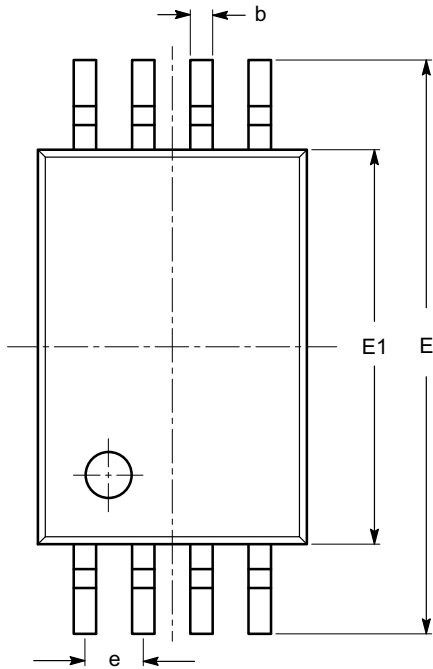
Symbol	Parameter	Min	Typ	Max	Unit
$f_{IN}$	Input frequency	50		173	MHz
$t_{LH}$ (Note 1)	Output rise time (measured at 0.8 V to 2.0 V)	0.3	0.7	1.0	nS
$t_{HL}$ (Note 1)	Output fall time (measured at 2.0 V to 0.8 V)	0.3	0.7	1.0	nS
$t_{JC}$	Jitter (cycle-to-cycle)	-	-	360	pS
$t_D$	Output duty cycle	45	50	55	%

1.  $t_{LH}$  and  $t_{HL}$  are measured into a capacitive load of 15 pF.

# P2040C

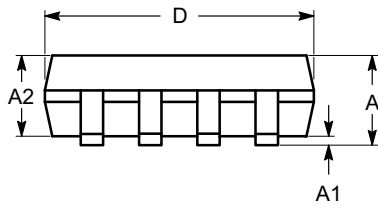
## PACKAGE DIMENSIONS

TSSOP8, 4.4x3  
CASE 948AL-01  
ISSUE O

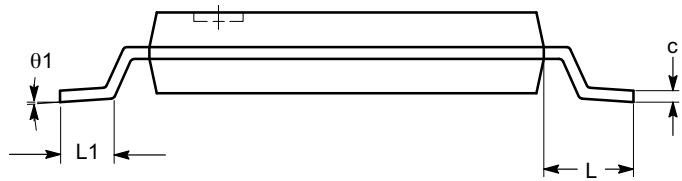


SYMBOL	MIN	NOM	MAX
A			1.20
A1	0.05		0.15
A2	0.80	0.90	1.05
b	0.19		0.30
c	0.09		0.20
D	2.90	3.00	3.10
E	6.30	6.40	6.50
E1	4.30	4.40	4.50
e	0.65 BSC		
L	1.00 REF		
L1	0.50	0.60	0.75
$\theta$	0°		8°

TOP VIEW



SIDE VIEW



END VIEW

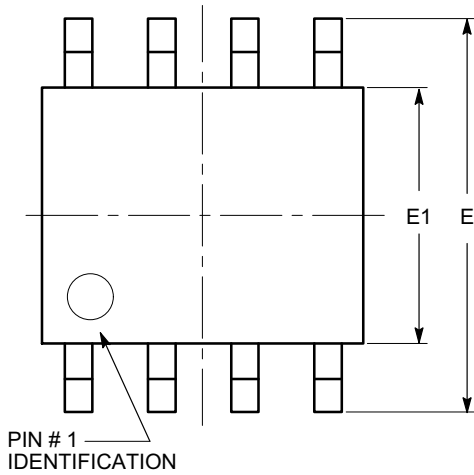
**Notes:**

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MO-153.

# P2040C

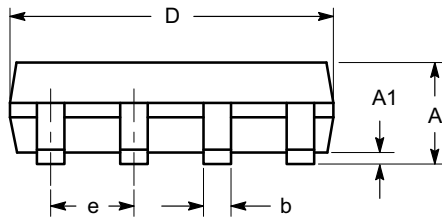
## PACKAGE DIMENSIONS

SOIC 8, 150 mils  
CASE 751BD-01  
ISSUE O

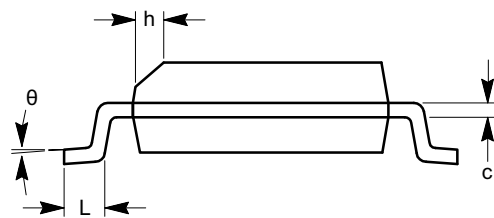


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	1.35		1.75
A1	0.10		0.25
b	0.33		0.51
c	0.19		0.25
D	4.80		5.00
E	5.80		6.20
E1	3.80		4.00
e	1.27 BSC		
h	0.25		0.50
L	0.40		1.27
$\theta$	0°		8°



SIDE VIEW



END VIEW


**Notes:**

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MS-012.

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**Table 6. ORDERING INFORMATION**

Part Number	Marking	Package Type	Temperature
P2040CF-08ST	P2040CF	8-Pin SOIC, TUBE, Pb Free	Commercial
P2040CF-08SR	P2040CF	8-Pin SOIC, TAPE & REEL, Pb Free	Commercial
P2040CF-08TT	P2040CF	8-Pin TSSOP, TUBE, Pb Free	Commercial
P2040CF-08TR	P2040CF	8-Pin TSSOP, TAPE & REEL, Pb Free	Commercial
I2040CF-08ST	I2040CF	8-Pin SOIC, TUBE, Pb Free	Industrial
I2040CF-08SR	I2040CF	8-Pin SOIC, TAPE & REEL, Pb Free	Industrial
I2040CF-08TT	I2040CF	8-Pin TSSOP, TUBE, Pb Free	Industrial
I2040CF-08TR	I2040CF	8-Pin TSSOP, TAPE & REEL, Pb Free	Industrial
X2040CF-08ST	X2040CF	8-Pin SOIC, TUBE, Pb Free	Automotive
X2040CF-08SR	X2040CF	8-Pin SOIC, TAPE & REEL, Pb Free	Automotive
X2040CF-08TT	X2040CF	8-Pin TSSOP, TUBE, Pb Free	Automotive
X2040CF-08TR	X2040CF	8-Pin TSSOP, TAPE & REEL, Pb Free	Automotive
P2040CG-08ST	P2040CG	8-Pin SOIC, TUBE, Green	Commercial
P2040CG-08SR	P2040CG	8-Pin SOIC, TAPE & REEL, Green	Commercial
P2040CG-08TT	P2040CG	8-Pin TSSOP, TUBE, Green	Commercial
P2040CG-08TR	P2040CG	8-Pin TSSOP, TAPE & REEL, Green	Commercial
I2040CG-08ST	I2040CG	8-Pin SOIC, TUBE, Green	Industrial
I2040CG-08SR	I2040CG	8-Pin SOIC, TAPE & REEL, Green	Industrial
I2040CG-08TT	I2040CG	8-Pin TSSOP, TUBE, Green	Industrial
I2040CG-08TR	I2040CG	8-Pin TSSOP, TAPE & REEL, Green	Industrial
X2040CG-08ST	X2040CG	8-Pin SOIC, TUBE, Green	Automotive
X2040CG-08SR	X2040CG	8-Pin SOIC, TAPE & REEL, Green	Automotive
X2040CG-08TT	X2040CG	8-Pin TSSOP, TUBE, Green	Automotive
X2040CG-08TR	X2040CG	8-Pin TSSOP, TAPE & REEL, Green	Automotive

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