

LCD Panel EMI Reduction IC

Features

- FCC approved method of EMI attenuation.
- Provides up to 15dB of EMI suppression
- Generates a low EMI spread spectrum clock of the input frequency
- 50MHz to 173MHz input frequency range
- Optimized for 54MHz, 65MHz, 81MHz, 140MHz, and 162MHz 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
- 3.3V 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

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 result 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’.

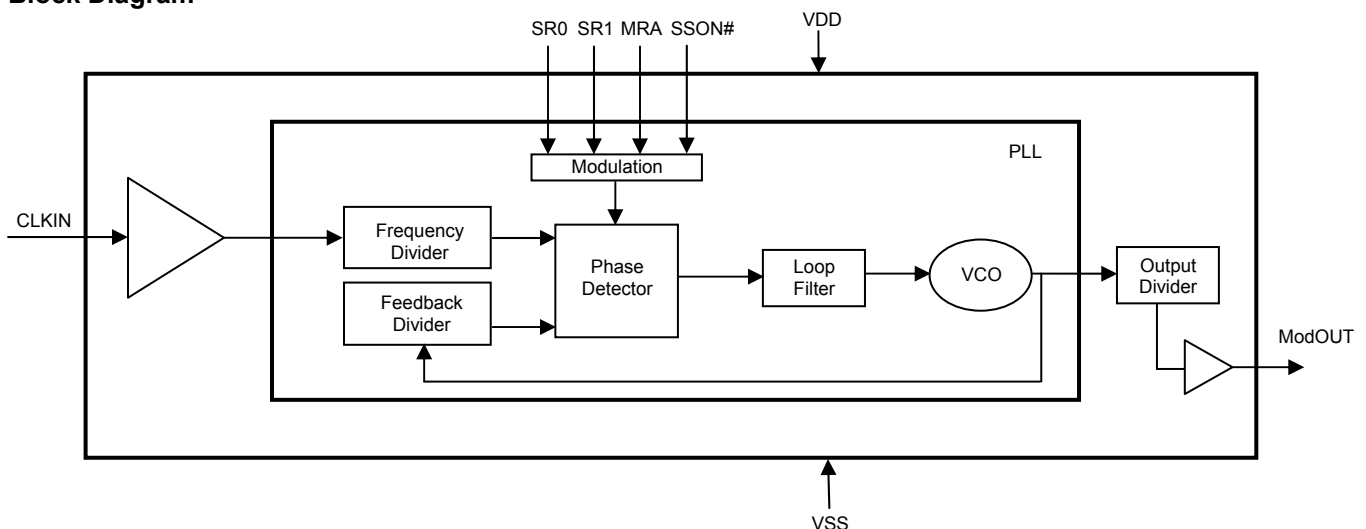
Product Description

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

Applications

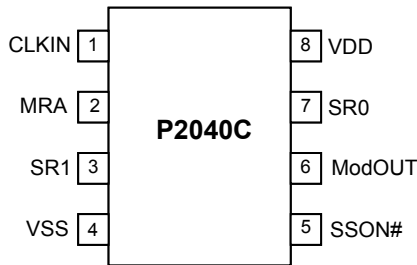
The P2040C is targeted towards digital flat panel applications for Notebook PCs, Palm-size PCs, Office Automation Equipments and LCD Monitors.

Block Diagram



rev 1.6

Pin Configuration



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. |

Modulation Selection (Commercial) – Table 1

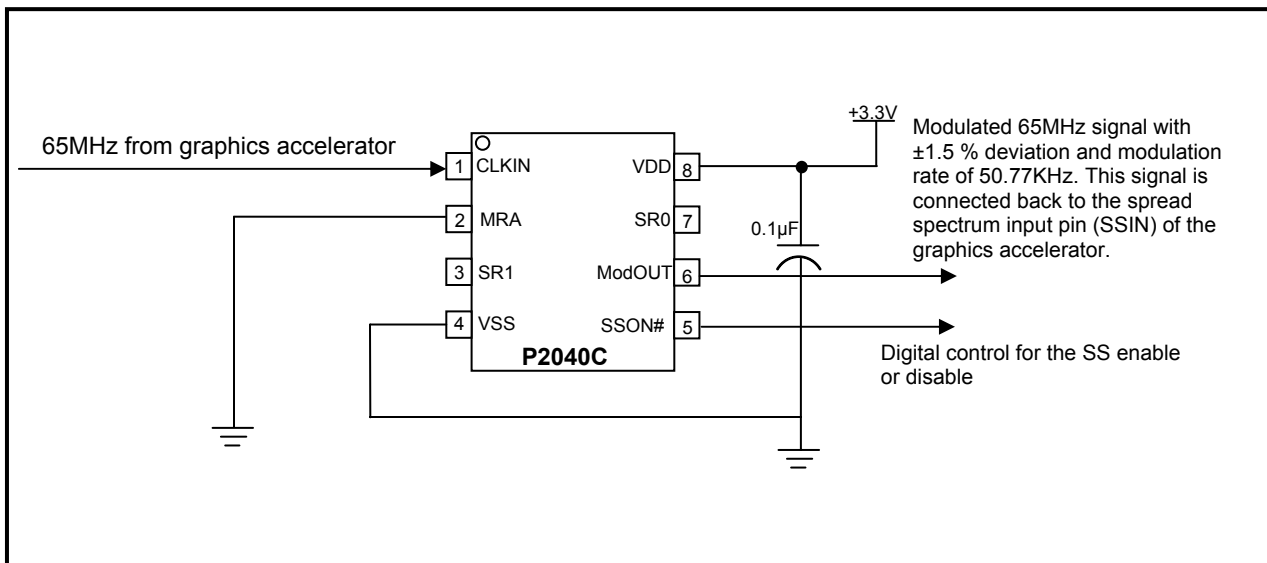
| MRA | SR1 | SR0 | Spreading Range | | | | | Modulation Rate |
|-----|-----|-----|-----------------|-------|-------|--------|--------|---------------------|
| | | | 54MHz | 65MHz | 81MHz | 140MHz | 162MHz | |
| 0 | 0 | 0 | ±1.4% | ±1.2% | ±1.0% | ±0.6% | ±0.4% | (Fin/80) * 62.49KHz |
| 0 | 0 | 1 | ±2.0%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

Spread Spectrum Selection

Table 1 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 50MHz to 173MHz. For a 65MHz pixel clock frequency, a spreading selection of MRA=0, SR1=1 and SR0 =1 provides a percentage deviation of $\pm 1.50\%$ (see Table 1). This result in frequency on ModOUT being swept from 64.03MHz to 65.98MHz at a modulation rate of 50.77KHz (see Table 1). 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.

Application Schematic for Mobile LCD Graphics Controllers



rev 1.6

Absolute Maximum Ratings

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

Note: These are stress ratings only and are not implied for functional use. Exposure to absolute maximum ratings for prolonged periods of time may affect device reliability.

DC Electrical Characteristics

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

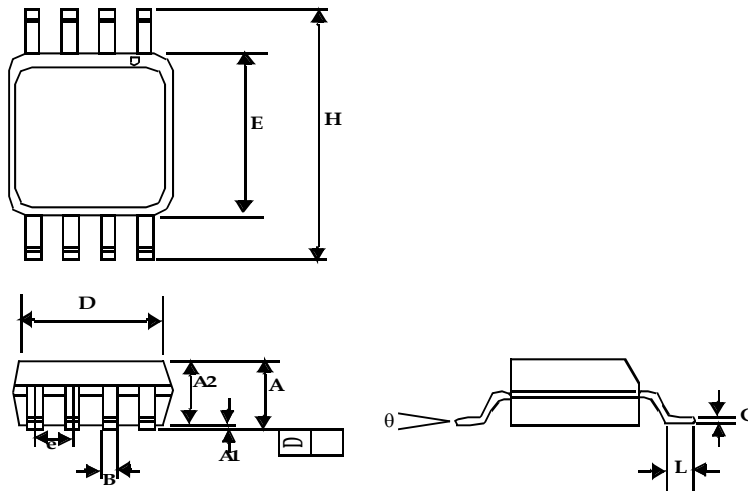
| Symbol | Parameter | Min | Typ | Max | Unit |
|------------------|-----------------------------------------------------------------|-----------|------|-----------|------|
| V _{IL} | Input low voltage | VSS - 0.3 | - | 0.8 | V |
| V _{IH} | Input high voltage | 2.0 | - | VDD + 0.3 | V |
| I _{IL} | Input low current (pull-up resistor on inputs SR0, SR1 and MRA) | - | - | -40 | µA |
| I _{IH} | Input high current (pull-down resistor on input SSON#) | - | - | 40 | µA |
| V _{OL} | Output low voltage (VDD = 3.3V, I _{OL} = 20mA) | - | - | 0.4 | V |
| V _{OH} | Output high voltage (VDD = 3.3V, I _{OL} = 20mA) | 2.5 | - | - | V |
| I _{DD} | Static supply current standby mode | - | 0.7 | - | mA |
| I _{CC} | Dynamic supply current (3.3V and 10pF 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 | - | Ω |

AC Electrical Characteristics

| Symbol | Parameter | Min | Typ | Max | Unit |
|-------------------|---------------------------------------------|-----|-----|-----|------|
| f _{IN} | Input frequency | 50 | | 173 | MHz |
| t _{LH} * | Output rise time (measured at 0.8V to 2.0V) | 0.3 | 0.7 | 1.0 | nS |
| t _{HL} * | Output fall time (measured at 2.0V to 0.8V) | 0.3 | 0.7 | 1.0 | nS |
| t _{JC} | Jitter (cycle to cycle) | - | - | 360 | pS |
| t _D | Output duty cycle | 45 | 50 | 55 | % |

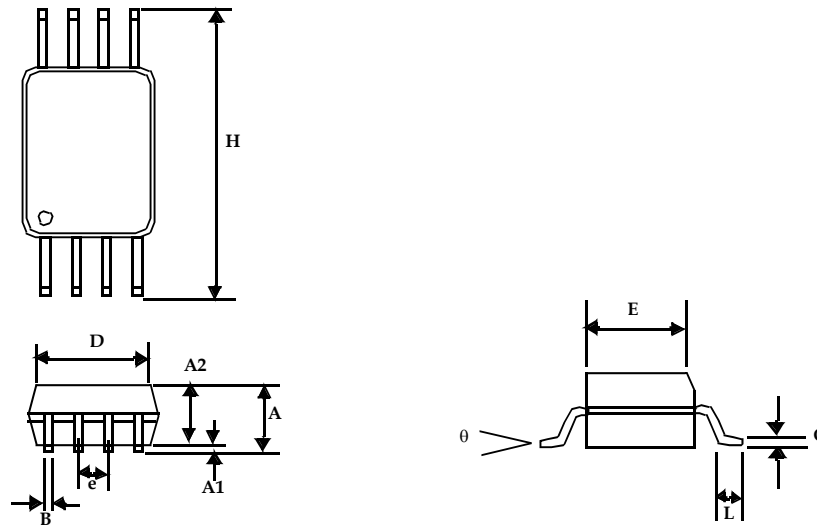
*t_{LH} and t_{HL} are measured into a capacitive load of 15pF

8-lead (150-mil) SOIC Package



| Symbol | Dimensions | | | |
|--------|------------|-------|-------------|------|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| A1 | 0.004 | 0.010 | 0.10 | 0.25 |
| A | 0.053 | 0.069 | 1.35 | 1.75 |
| A2 | 0.049 | 0.059 | 1.25 | 1.50 |
| B | 0.012 | 0.020 | 0.31 | 0.51 |
| C | 0.007 | 0.010 | 0.18 | 0.25 |
| D | 0.193 BSC | | 4.90 BSC | |
| E | 0.154 BSC | | 3.91 BSC | |
| e | 0.050 BSC | | 1.27 BSC | |
| H | 0.236 BSC | | 6.00 BSC | |
| L | 0.016 | 0.050 | 0.41 | 1.27 |
| θ | 0° | 8° | 0° | 8° |

8-lead TSSOP (4.40-MM Body)



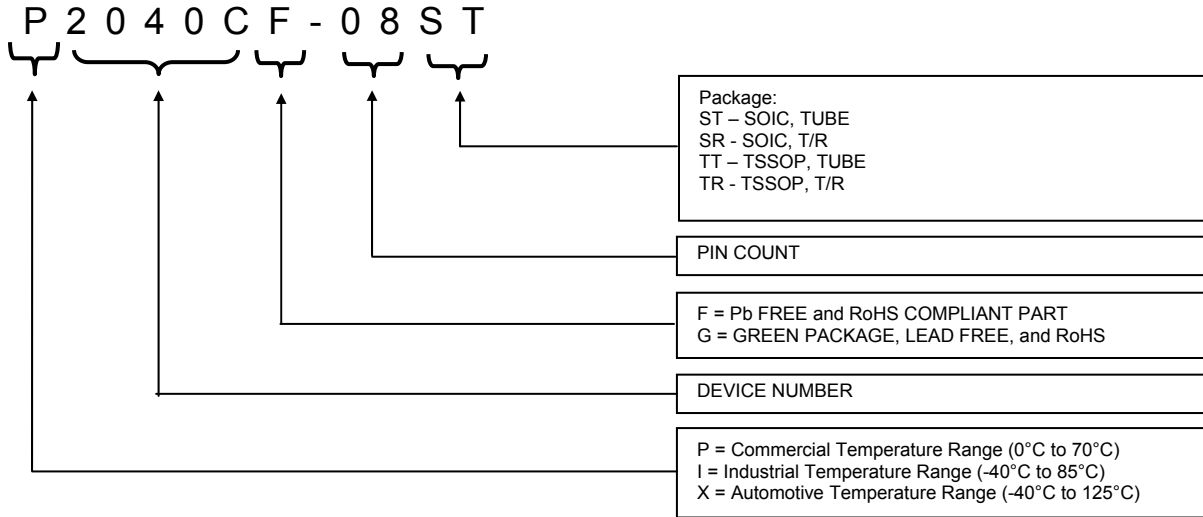
| Symbol | Dimensions | | | |
|----------|------------|-------|-------------|------|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| A | | 0.043 | | 1.10 |
| A1 | 0.002 | 0.006 | 0.05 | 0.15 |
| A2 | 0.033 | 0.037 | 0.85 | 0.95 |
| B | 0.008 | 0.012 | 0.19 | 0.30 |
| c | 0.004 | 0.008 | 0.09 | 0.20 |
| D | 0.114 | 0.122 | 2.90 | 3.10 |
| E | 0.169 | 0.177 | 4.30 | 4.50 |
| e | 0.026 BSC | | 0.65 BSC | |
| H | 0.252 BSC | | 6.40 BSC | |
| L | 0.020 | 0.028 | 0.50 | 0.70 |
| θ | 0° | 8° | 0° | 8° |

rev 1.6

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 |

Device Ordering Information





PulseCore Semiconductor Corporation
1715 S. Bascom Ave Suite 200
Campbell, CA 95008
Tel: 408-879-9077
Fax: 408-879-9018
www.pulsecoresemi.com

Copyright © PulseCore Semiconductor
All Rights Reserved
Preliminary Information
Part Number: P2040C
Document Version: v1.6

Note: This product utilizes US Patent # 6,646,463 Impedance Emulator Patent issued to PulseCore Semiconductor, dated 11-11-2003

© Copyright 2006 PulseCore Semiconductor Corporation. All rights reserved. Our logo and name are trademarks or registered trademarks of PulseCore Semiconductor. All other brand and product names may be the trademarks of their respective companies. PulseCore reserves the right to make changes to this document and its products at any time without notice. PulseCore assumes no responsibility for any errors that may appear in this document. The data contained herein represents PulseCore's best data and/or estimates at the time of issuance. PulseCore reserves the right to change or correct this data at any time, without notice. If the product described herein is under development, significant changes to these specifications are possible. The information in this product data sheet is intended to be general descriptive information for potential customers and users, and is not intended to operate as, or provide, any guarantee or warranty to any user or customer. PulseCore does not assume any responsibility or liability arising out of the application or use of any product described herein, and disclaims any express or implied warranties related to the sale and/or use of PulseCore products including liability or warranties related to fitness for a particular purpose, merchantability, or infringement of any intellectual property rights, except as express agreed to in PulseCore's Terms and Conditions of Sale (which are available from PulseCore). All sales of PulseCore products are made exclusively according to PulseCore's Terms and Conditions of Sale. The purchase of products from PulseCore does not convey a license under any patent rights, copyrights; mask works rights, trademarks, or any other intellectual property rights of PulseCore or third parties. PulseCore does not authorize its products for use as critical components in life-supporting systems where a malfunction or failure may reasonably be expected to result in significant injury to the user, and the inclusion of PulseCore products in such life-supporting systems implies that the manufacturer assumes all risk of such use and agrees to indemnify PulseCore against all claims arising from such use.