Power Supply Sequencer with Power-up System Monitoring X80200/01/02/03/04

FEATURES

- **Sequence three voltage supplies independently**
  - **—Core and Logic I/O VCC power sequencer for processor supplies**
  - **—Power up and power down control**
  - **—Voltage monitors have undervoltage lockout**
  - **—Internal charge pump drives external N-channel FET switches**
  - **—Cascadable to sequence more than 3 supplies**
  - **—Time based or voltage based sequencing**
- **Status register bits monitor gate output status**
- **SMBus compatible Interface**
- **Slave address identification for up to 8 power sequencers (24 supplies) on the same bus**
- **Surface mount 20-pin TSSOP Package**

APPLICATIONS

- **Distributed Power Supply Designs**
- **Multi-voltage systems**
- **Multiprocessor systems**
- **Embedded Processor Applications**
- **Digital Signal Processors, FPGAs, ASICs, Memory Controllers**
- **N + 1 Redundant Power Supplies**
- **Support for SSI – Server System Infrastrcture Specifications**
- **-48V Hotswap Power Backplane/Distribution**
- **Card Insertion Detection and Power**
- **Power Sequencing DC-DC Supplies**
- **Databus Power Interfacing**
- **Custom Industrial Power Backplanes**
- **Other: ATE, Data Acquisition, Mass Storage, Servers, Data com, Wireless Basestations**

DESCRIPTION

The X80200 power sequencer provides a flexible approach for handling difficult system power up conditions. The X80200 includes control of up to three voltage supplies and can be cascaded to control additional supplies. The device contains independent undervoltage lockout for each controlled voltage.

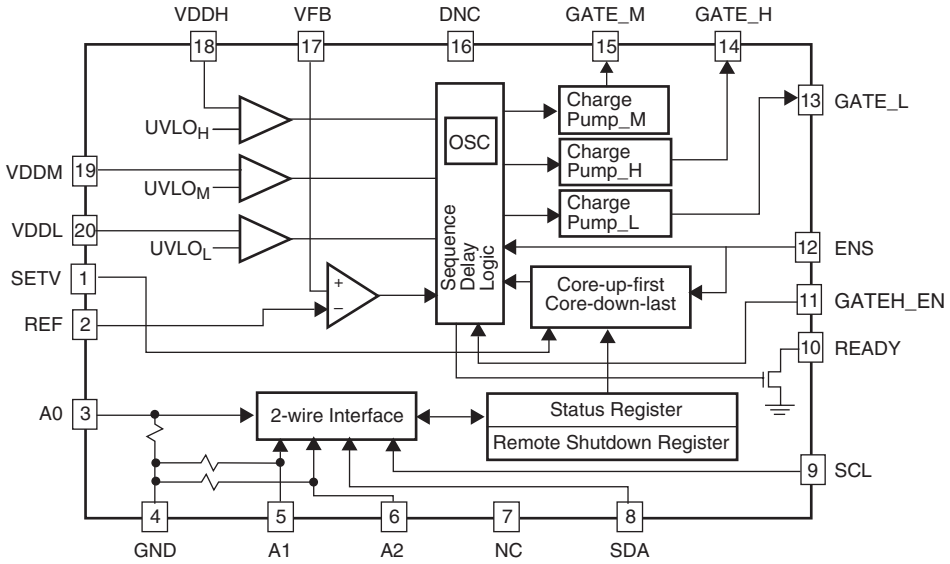
The three voltage control circuits allow sequencing for primary, core, and I/O voltages. The core and I/O supplies are linked together with a comparator or a timer allowing a tight coupling between these two supplies. The sequencing may be either voltage based or time based.

The X80200 contains separate charge pumps to control external N-channel power FETs for each of the supplies. The charge pumps provide the high gate control voltage necessary for efficient operation of the FET switches.

The X80200 turns on the primary voltage to the system when the voltage source is steady. This primary FET switch turn-on can be delayed with an external RC circuit. For the secondary voltage sources, the device has a built-in “core-up-first and core-down-last” sequencing logic which is ideal for high performance processors, DSPs and ASICs.

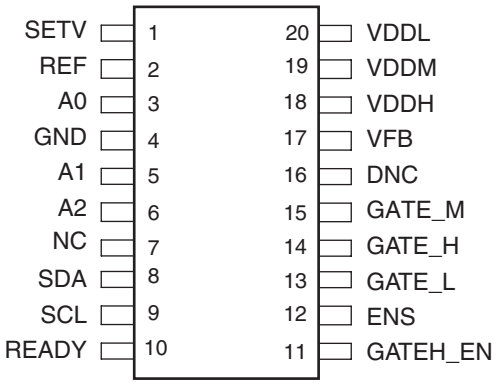
The serial bus can be used to monitor the status or turn off each of the external power switches. The X80200 has 3 slave address bits that allow up to 8 devices to be connected to the same bus.

FUNCTIONAL DIAGRAM



PIN CONFIGURATION

20-lead TSSOP



ORDERING INFORMATION

$UVLO_H$	$UVLO_M$	$UVLO_L$	Package	PART NUMBER
4.5	3.0	0.9	TSSOP	X80200V20I
4.5	2.25	0.9	TSSOP	X80201V20I
3.0	2.25	1.7	TSSOP	X80202V20I
3.0	2.25	0.9	TSSOP	X80203V20I
3.0	0.9	0.9	TSSOP	X80204V20I

PIN DESCRIPTIONS

Pin	Name	Description
1	SETV	Set Voltage. This pin is used for voltage based power sequencing of supplies VDDM and VDDL. If unused connect to ground.
2	REF	Reference voltage. This pin is used for voltage based sequencing. The voltage on this pin is compared to the voltage on the VFB pin and provides the threshold for turn on of the GATE_M output. Either a voltage source or external resistor divider can be used to provide the reference. If time based sequencing is used this pin should be tied to VDDH.
3	A0	Slave address pin assignment. It has an Internal pull down resistor. (>10MΩ typical)
4	GND	Voltage Ground.
5	A1	Slave address pin assignment. It has an Internal pull down resistor. (>10MΩ typical)
6	A2	Slave Address pin assignment. It has an Internal pull down resistor. (>10MΩ typical)
7	NC	No internal connections.
8	SDA	Serial bus data input / output pin.
9	SCL	Serial bus clock input pin.
10	READY	READY Output Pin: This open-drain output pin goes LOW while VDDH is below $UVLO_H$ and remains LOW for t_{PURST} after VDDH goes above $UVLO_H$. READY goes HIGH after t_{PURST}.
11	GATEH_EN	GATE_H Enable. When this pin is HIGH and VDDH > $UVLO_H$ the charge pump of the GATE_H pin turns on and the output drives HIGH. When this pin is LOW, the charge pump is disabled and the GATE_H output is LOW. An external RC time delay can be connected between the enable signal and this pin to delay the GATE_H turn on.
12	ENS	Enable Sequence. This pin is used for time based power sequencing of supplies VDDM and VDDL. If unused, connect to ground.
13	GATE_L	GATE_L Output: This output is connected to the gate of an (external) Power Switch “L”. The GATE_L pin is driven HIGH when charge pump L is enabled and pulled LOW when the charge pump is disabled.
14	GATE_H	GATE_H Output: This output is connected to the gate of a (external) Power Switch “H”. The GATE_H pin driven HIGH when charge pump H is enabled and pulled LOW when the charge pump is disabled.
15	GATE_M	GATE_M Output: This output is connected to the gate of a (external) Power Switch “M”. The GATE_M pin driven HIGH when charge pump M is enabled and pulled LOW when the charge pump is disabled.
16	DNC	Do not connect (must be left floating).
17	VFB	Voltage Feedback Pin. This input pin is used with voltage based power sequencing to monitor the level of a previously turned on supply. If unused connect to ground.
18	VDDH	Primary supply voltage (typically 5V).
19	VDDM	Monitored Supply Voltage “M” input.
20	VDDL	Monitored Supply Voltage “L” input.

ELECTRICAL CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS

Temperature under bias .....–65°C to +135°C
Storage temperature .....–65°C to +150°C
Voltage on given pin (Power SequencingFunctions):
All V_{DD} pins 7V
Lead temperature (soldering, 10 seconds).....300°C

COMMENT

Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only; functional operation of the device (at these or any other conditions above those listed in the operational sections of this specification) is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Temperature	Min.	Max.
Industrial	–40°C	+85°C

POWER SEQUENCING CONTROL CIRCUITS

(Over the recommended operating conditions unless otherwise specified).

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
DC CHARACTERISTICS – Undervoltage Lockout Comparators						
V_{DDH}	Supply Operating Range	3.05		5.5	V	
V_{DDM}	Supply Operating Range	0.95		5.5	V	
V_{DDL}	Supply Operating Range	0.95		5.5	V	
I_{DDH}	Supply Current		2.5		mA	V_{DDH} = 5.5V
I_{DDH}	Supply Current		200		µA	V_{DDH} = 3.1V
$UVLO_H$	Undervoltage lockout for VDDH					
	X80200	4.425	4.5	4.575	V	
	X80201	4.425	4.5	4.575		
	X80202	2.95	3.0	3.05		
	X80203	2.95	3.0	3.05		
	X80204	2.95	3.0	3.05		
$UVLO_M$	Undervoltage lockout for VDDM				V	
	X80200	2.95	3.0	3.05		
	X80201	2.2	2.25	2.3		
	X80202	2.2	2.25	2.3		
	X80203	2.2	2.25	2.3		
	X80204	0.875	0.9	0.925		
$UVLO_L$	Undervoltage lockout for VDDL				V	
	X80200	0.875	0.9	0.925		
	X80201	0.875	0.9	0.925		
	X80202	1.65	1.7	1.75		
	X80203	0.875	0.9	0.925		
	X80204	0.875	0.9	0.925		
V_{HYS}	$UVLO_{H,M,L}$ comparator Hysteresis		30		mV	

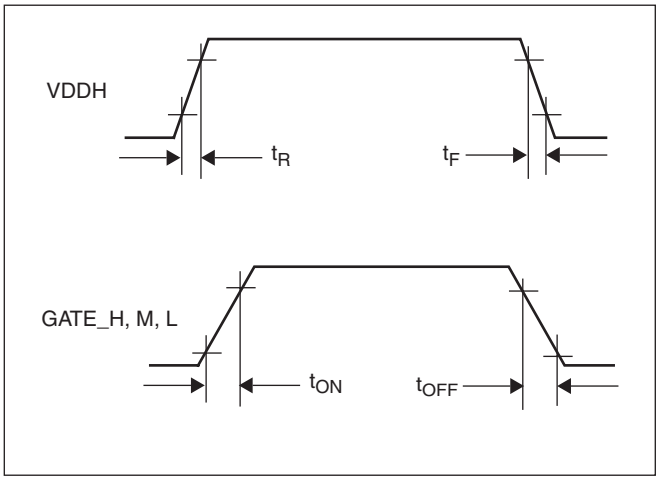
POWER SEQUENCING CONTROL CIRCUITS (Continued)
(Over the recommended operating conditions unless otherwise specified).

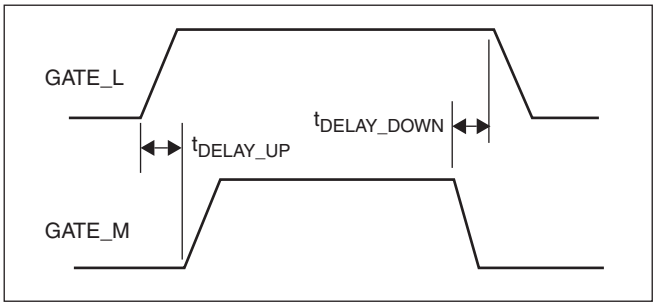
Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
DC CHARACTERISTICS – Gates and Others						
V_{IH}	Voltage Input Valid High for ENS, SETV, GATEH_EN	VDDH x 0.7		VDDH + 0.5	V	
V_{IL}	Voltage Input Valid Low for ENS, SETV, GATEH_EN	-0.5		VDDH x 0.3	V	
V_{OL}	Output LOW Voltage (SDA, READY)			0.4	V	
V_{GATE_ON}	GATE_H, GATE_M	9.0	10	11.0	V	V_{DDH} = 5.5V
	GATE_L	7.0	8	9.0		
	GATE_H, GATE_M	7.0	8	9.0	V	V_{DDH} = 3.1V
	GATE_L	6.0	7.0	8.0		
V_{GATE_OFF}	Gate Voltage Drive (OFF) for GATE_H, GATE_M, GATE_L	0		0.1	V	
I_{GATE_ON}	Gate Current Drive (ON) for GATE_H, GATE_M, GATE_L	20	35	45	µA	Note 1
I_{GATE_OFF}	Gate Sinking Current Drive (OFF) for GATE_H, GATE_M, GATE_L	9	10	11	mA	V_{DDH} = 5.5V, V_{DDM} = 0V, V_{DDL} = 0V, GATEH_EN = 0, GATE_H = 5.5, GATE_L = 5.5, GATE_M = 5.5, Note 1
V_{HYST}	VFB comparator	15	20	25	mV	Note 1, 25°C

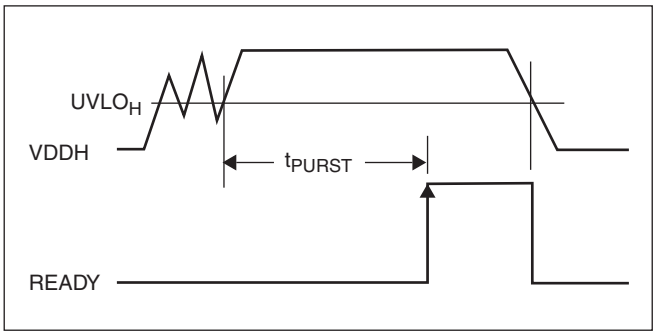
POWER SEQUENCING CONTROL CIRCUITS (Continued)

(Over the recommended operating conditions unless otherwise specified).

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
AC CHARACTERISTICS						
t_{PURST}	Delayed READY Output (READY output delayed after VDDH rises above $UVLO_H$)	10	12	15	ms	V_{DDH} = 5.5V
			40	80		V_{DDH} = 3.1V
t_{DELAY_UP}		600	750	900	µs	V_{DDH} = 5.5V, C_{GATE} = 0
				6	ms	V_{DDH} = 3.1V, C_{GATE} = 0
t_{DELAY_DOWN}		700	800	900	µs	V_{DDH} = 5.5V
				6	ms	V_{DDH} = 3.1V
t_{OFF}	GATE_H, GATE_M, GATE_L turn-off time			40	µs	V_{DDH} = 5.5V, Note 1
				80	µs	V_{DDH} = 3.1V, Note 1
t_{ON}	GATE_H, GATE_M, GATE_L turn-on time	0.5	0.6	0.7	ms	V_{DDH} = 5.5V, Note 1
		2		5	ms	V_{DDH} = 3.1V, Note 1
t_R	V_{DDH} Rise Time	1.0			µs	Note 1
t_F	V_{DDH} Fall Time	1.0			µs	Note 1







SERIAL BUS INTERFACE ELECTRICAL CHARACTERISTICS

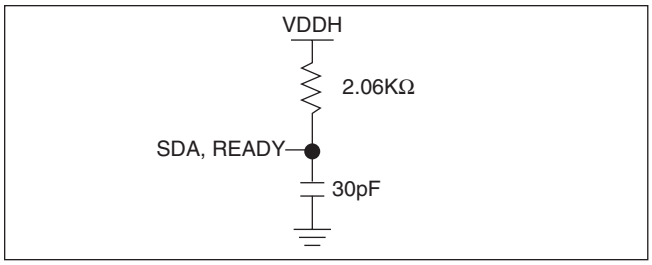
Symbol	Parameter	Min.	Max.	Unit	Test Conditions
V_{IL}	Signal Input Low Voltage		0.8	V	
V_{IH}	Signal Input High Voltage	2.0		V	
V_{OL}	Signal Output Low Voltage		0.4	V	Note 1, $I_{pullup} \geq 4mA$
C_{BUS}	Capacitive Load per bus segment		400	pF	Note 1

CAPACITANCE

Symbol	Parameter	Max.	Unit	Test Conditions
C_{OUT}	Output Capacitance (SDA)	8	pF	V_{OUT} = 0V, Note 1
C_{IN}	Input Capacitance (SCL)	6	pF	V_{IN} = 0V, Note 1

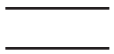
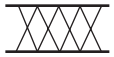
Note: (1) Guaranteed by device characterization.

EQUIVALENT A.C. OUTPUT LOAD CIRCUIT FOR VDDH = 5V



A.C. TEST CONDITIONS

Input pulse levels	V_{CC} x 0.1 to V_{CC} x 0.9
Input rise and fall times	10ns
Input and output timing levels	V_{CC} x 0.5
Output load	Standard output load

WAVEFORM	INPUTS	OUTPUTS
	Must be steady	Will be steady
	May change from LOW to HIGH	Will change from LOW to HIGH
	May change from HIGH to LOW	Will change from HIGH to LOW
	Don't Care: Changes Allowed	Changing: State Not Known
	N/A	Center Line is High Impedance

BUS INTERFACE AC TIMING

Symbol	Parameter	SMBus		2-Wire Bus		Units	Test Condition
		Min.	Max.	Min.	Max.		
f_{SCL}	Clock Frequency	10	100		400	kHz	
t_{CYC}	Clock Cycle Time	10		2.5		µs	
t_{HIGH}	Clock High Time	4.0	50	0.6		µs	
t_{LOW}	Clock Low Time	4.7		1.3		µs	
$t_{SU:STA}$	Start Setup Time	4.7		0.6		µs	
$t_{HD:STA}$	Start Hold Time	4.0		0.6		µs	
$t_{SU:STO}$	Stop Setup Time	4.0		0.6		µs	
$t_{SU:DAT}$	SDA Data Input Setup Time	250		100		ns	
$t_{HD:DAT}$	SDA Data Hold Time	300		0		ns	
t_R	SCL and SDA Rise Time: TR = (V_{ILMAX} - 0.15) to		1000		300	ns	Note 1
t_F	SCL and SDA Fall Time: TF = (V_{IHMIN} - 0.15) to		300		300	ns	Note 1
t_{AA}	SCL Low to SDA Data Output Valid Time	550	1100	250	1100	ns	Note 1
t_{DH}	SDA Data Output Hold Time	300		0		ns	Note 1
T_I	Noise Suppression Time Constant at SCL and	50		50		ns	Note 1
t_{BUF}	Bus Free Time (Prior to Any Transmission)	4.7		1.3		µs	Note 1
$t_{SU:A}$	A0, A1, A2 Setup Time	0		0		ns	
$t_{HD:A}$	A0, A1, A2 Hold Time	0		0		ns	

TIMING DIAGRAMS

Figure 1. Bus Timing

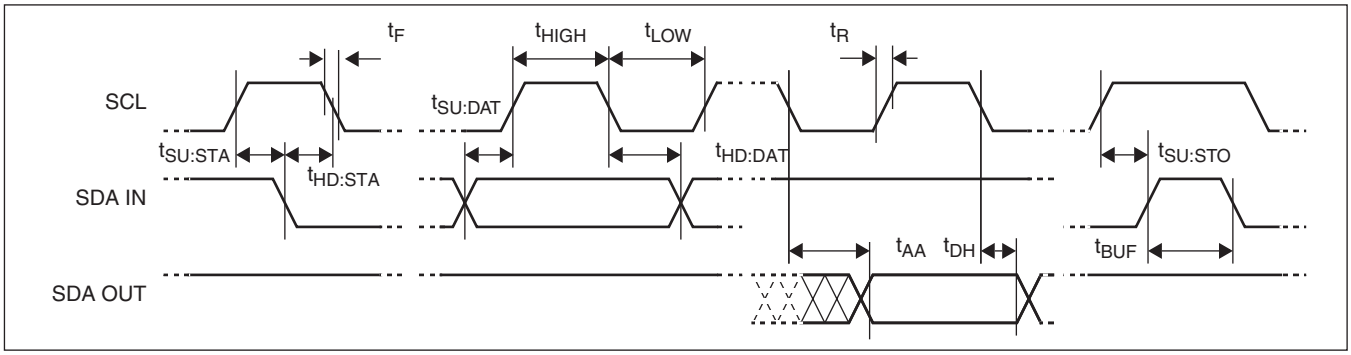
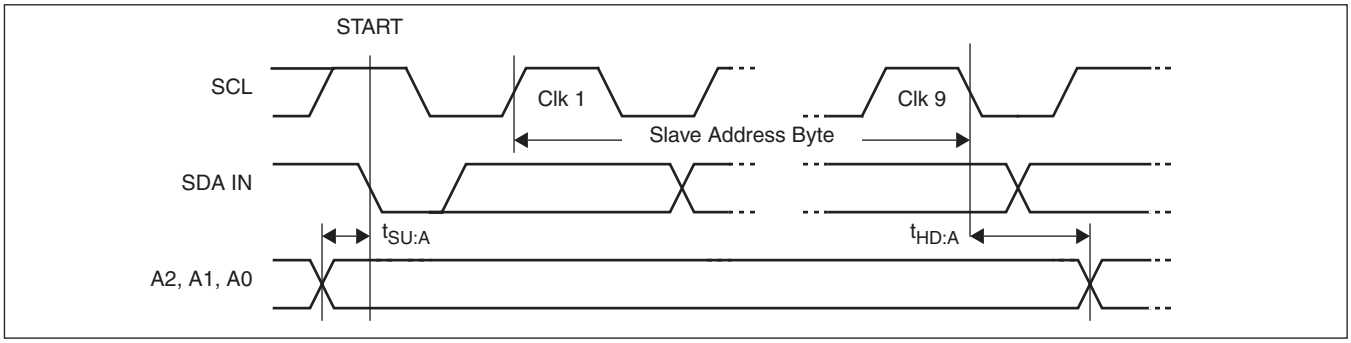


Figure 2. Address Pin Timing



PRINCIPLES OF OPERATION

Power Sequencing Control (PSC)

The Xicor X80200 supports a variety of sequencing applications. The sequencing can be voltage based or time based. Some examples are shown in Figure 13, Figure 14, and Figure 15 in the APPLICATIONS section. The X80200 allows for designs that can control the power sequencing of up to three voltage supplies. For systems with more than three supplies, the X80200 may be cascaded.

Basic Functions

VDDH is the primary voltage for the X80200. Once VDDH rises above the primary undervoltage lockout level ($UVLO_H$) for time t_{PURST}, the READY output goes HIGH indicating that the supply power is good. By connecting READY directly to GATEH_EN, the GATE_H output goes high immediately, turning on the power FET connected in series with VDDH. The system primary voltage may be delayed by using an external RC circuit between READY and GATEH_EN.

VDDH must be stable before VDDM and VDDL supplies are monitored and power sequencing begins.

The second supply voltage (I/O supply) is monitored by the VDDM pin. VDDM must be greater than the I/O supply undervoltage lockout level ($UVLO_M$) prior to any activation of the GATE_M output. The VDDM voltage is used to turn on the charge pump that drives the GATE_M output.

The third supply (core supply) is monitored by the VDDL pin. VDDL must be greater than the core supply undervoltage lockout level ($UVLO_L$) prior to any activation of the GATE_L output. The VDDL voltage is used to turn on the charge pump that drives the GATE_M output.

Power Sequencing Functions

X80200 provides two options for power sequencing. In time based sequencing, the ENS (Enable Sequence) input signals that the core and I/O voltages are to turn on with a fixed time relationship. In voltage based sequencing. the SETV (Set Voltage) initiates turn on of the core voltage. The I/O voltage remains off until the core voltage reaches a set threshold.

In both cases the X80200 uses a core-voltage first and core voltage-last power up/down algorithm.

Time Based Power Sequencing

A rising edge (LOW to HIGH) transition of the ENS pin turns on the charge pump that drives the GATE_L output.

A falling edge (HIGH to LOW) transition of the ENS signal turns off the charge pump that drives the GATE_M output. This technique provides a “forced” core-voltage-first power up and core-voltage-last power down algorithm. The ENS signals does not control the ramp up/down rates of the GATE_M or GATE_L outputs.

In the absence of an externally provided ENS signal, the ENS pin can be connected in a number of different ways.

– ENS can connect to the VDDH pin. In this case, the GATE_H and GATE_L outputs are enabled at the same time. GATE_H could be delayed by using an external RC timer between READY and GATEH_EN to provide a sequence where VDDL is the first supply voltage applied to the system.

– ENS can connect to a delayed READY signal, so that the VDDL voltage follows the VDDH voltage by a fixed time.

– ENS can connect to the system side of the VDDH FET, so the VDDL voltage will follow immediately after the primary supply is applied to the system.

See "FUNCTIONAL DESCRIPTION" on page 10 for details on timing and ramp up.

Voltage Based Power Sequencing

In this configuration, the drain of the “L” MOSFET is connected to the VFB input of the X80200, the ENS pin is tied to ground and a resistor divider provides a reference voltage to the REF pin.

A LOW to HIGH transition of the SETV pin turns on the GATE_L output. This turns on the “L” MOSFET. Once the drain of this FET reaches the REF level, GATE_M turns on. Since the trigger for the GATE_M output is selected by a threshold level, the user has the ability to specify relative core and I/O voltage sequencing.

System Monitoring and Remote Shutdown

The X80200 Status Register contains fault detection bits that indicate the status of the GATE_H, GATE_M, and GATE_L pins. These bits are Stat_GATEH, Stat_GATEM, and Stat_GATEL. The status register can be read via 2-wire bus. This feature allows for system monitoring of the power sequencing of supplies.

The system can turn off the FETs by writing to the Remote Shutdown Register through the 2-wire interface. There are three turn off selections. See "Remote Shutdown Register (RSR) (Volatile)" on page 13 for more details.

FUNCTIONAL DESCRIPTION

Voltage Inputs. The X80200 has three voltage monitors for power sequencing: the VDDH (primary voltage), VDDM (I/O voltage), and VDDL (core voltage). These voltage monitors operate independently of each other.

Primary Voltage VDDH

This voltage is the primary voltage for the device and is required before X80200 can power sequence VDDM and VDDL. As VDDH powers up, it is compared to an internal $UVLO_H$ reference. This undervoltage lockout level is preset at the factory. For information on this settings, See "ORDERING INFORMATION" on page 2. For custom programmed levels, contact Xicor.

The READY output pin reflects the condition of the VDDH input. READY is LOW as long as VDDH is below $UVLO_H$ and remains LOW for a period of t_{PURST} after VDDH crosses $UVLO_H$, see Figure 4. Once VDDH rises above $UVLO_H$ and remains stable for t_{PURST}, the READY output turns ON. If READY connects directly to the GATEH_EN pin, then the GATE_H charge pump turns on immediately. The turn on of the Gate_H charge pump can be delayed by using an external filter (RC filter) connected between the READY and GATEH_EN pins.

When VDDH drops below the $UVLO_H$ threshold, READY goes inactive immediately. For more details on this turn-off mechanism, See "Power Supply Failure Conditions" on page 11.

Secondary Voltages VDDM and VDDL

The VDDM and VDDL voltage inputs each have their own undervoltage lockout settings, $UVLO_M$, and $UVLO_L$, respectively. Each undervoltage lockout level is preset at the factory. For information on these settings, See "ORDERING INFORMATION" on page 2. For custom programmed levels, contact Xicor.

The GATE_M and GATE_ L charge pumps are OFF as long as VDDM, and VDDL are below their respective UVLO trip points. When READY is active and VDDM and VDDL go above their UVLO thresholds, the GATE_M and GATE_L charge pumps can be turned ON when activated as part of the power sequence desired. If VDDL or VDDM drop below the UVLO level the charge pumps turn off. For more details on this turn-off mechanism, See "Power Supply Failure Conditions" on page 11.

Sequence Delay Logic. This block contains the logic circuits that implement the power up and power down sequencing of the VDDH (GATE_H), VDDM (GATE_M), and VDDL (GATE_L) voltages. The sequencing protocol has a built-in “core-first-up and core-down-last” algorithm. On power-up the GATE_L signal turns on first, followed by GATE_M signal. During the power down, the GATE_M turns off first and the GATE_L signal follows.

The sequencing of the power supplies is primarily controlled and regulated via the SETV and the ENS (enable sequence) pins.

All charge pumps are designed to ramp up their respective gates at the same slew rate for the same load.

Time Based Power Sequencing (ENS option)

The ENS (Enable Sequence) pin controls the start of the ramp up/ramp down sequence for GATE_M and GATE_L in the time domain. See Figure 3.

ENS is an edge-triggered input. A rising edge (LOW to HIGH) on the ENS input turns on the charge pump that drives the GATE_L output. The slew rate of the GATE_L output depends on the external MOSFET and any load connected to it. (See Electrical Table). After a t_{DELAY_UP} time, the GATE_M charge pump turns ON. Again the slew rate is dependent on the load connected to GATE_M output.

The falling edge transition on the ENS pin (HIGH to LOW) turns off the charge pump that drives the GATE_M output. After a t_{DELAY_DOWN} time period, the GATE_L charge pump turns OFF.

Figure 3. Time Based Sequencing of GATE_M and GATE_L

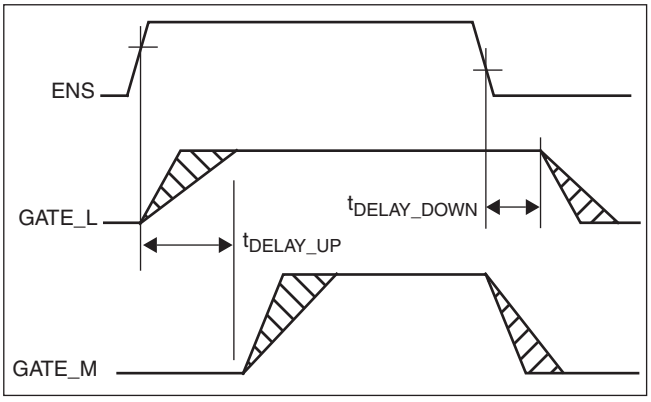
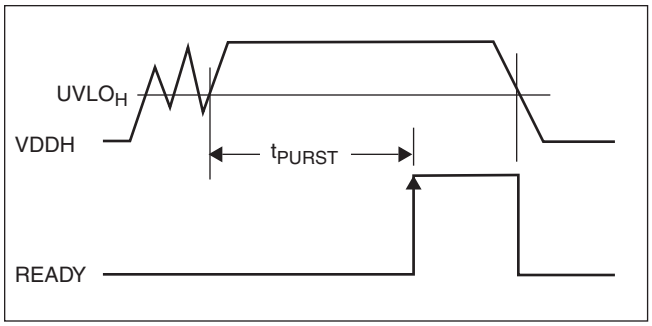


Figure 4. VDDH/READY sequencing



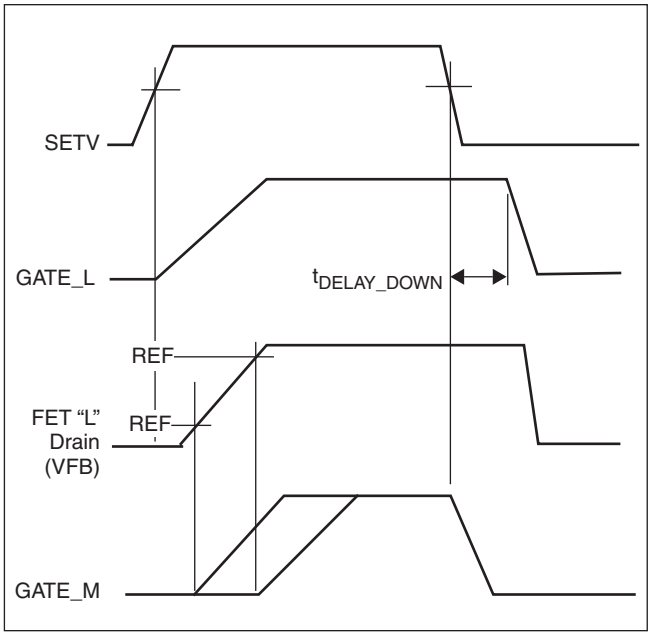
Voltage Based Power Sequencing (SETV Option)

Using the SETV pin allows for a voltage based sequencing of the GATE_L and GATE_M outputs. SETV is an edge triggered input signal. A LOW to HIGH transition on SETV immediately turns ON the charge pump for GATE_L. The GATE_L output then starts ramping up. In this configuration, the drain of the MOSFET "L" connects to the VFB pin and this voltage is compared to an external reference applied to the REF pin. The comparator turns on the charge pump for GATE_M once the voltage on VFB exceeds the voltage on REF. See Figure 5.

The voltage sequencing comparator has a 30mV hysteresis, so the GATE_M output does not oscillate as the core voltage powers up.

A High to Low transition of SETV turns OFF charge pump M and GATE_M is pulled low. After a t_{DELAY_DOWN} time period, charge pump L turns off and GATE_L is pulled low.

Figure 5. Voltage Based Sequencing of GATE_M and GATE_L



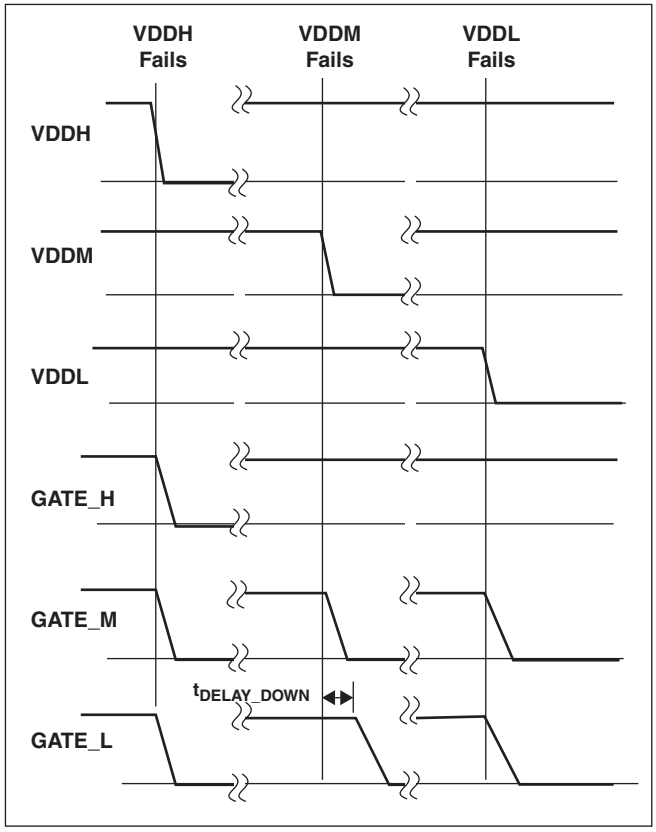
Power Supply Failure Conditions

Should there be a power failure of VDDH, GATE_H, GATE_M and GATE_L charge pumps are all turned OFF when VDDH falls below the UVLO$_H$ threshold.

Should there be a failure of the VDDM supply, the GATE_M charge pump turns off when VDDM falls below the UVLO$_M$ threshold. After a t_{DELAY_DOWN} time period, the GATE_L charge pump turns OFF.

Should there be a failure of the VDDL supply, the GATE_L and GATE_M charge pumps both turn off when VDDL falls below the UVLO$_L$ threshold.

Figure 6. Gate Control during individual Power Fail Conditions



Remote Monitoring Functions

The X80200 can monitor the status of the GATE_H, GATE_M, and GATE_L charge pump control signals. This allows an indirect way to monitor system voltages. The volatile status bits: Stat_GATEH, Stat_GATEM, and Stat_GATEL indicate the status of GATE_H, GATE_M and GATE_L output control signals, respectively. If the bit is a “1”, then the charge pump is being turned on. If the bit is a “0”, the output is turned off. Since the bits reflect the internal control signal and not the state of the output, external loading that prevents the charge pump from reaching the desired FET gate drive voltage will not be detected by reading the register.

These status bits can be read via the 2-wire serial bus. Refer to Status Register section for more information on how to read this register.

Several X80200 devices can be used to monitor many system voltages on different system cards on a backplane. Each X80200 has 3 slave address pins allowing up to 8 X80200 to be used on the same bus.

X80200 provides the user the ability to remotely turn-off the gates through software. See "Remote Shutdown Register (RSR) (Volatile)" on page 13 for more information.

REGISTER INFORMATION

The Register Block is organized as follows:

– Status Register (SR) (1 Byte). Located at address 00h.

– Remote Shut Down Register (RSR) (1 Byte). Located at address FFh.

Status Register (Volatile)

7	6	5	4	3	2	1	0
0	0	0	0	STAT_ GATEH	STAT_ GATEM	STAT_ GATEL	WEL

The Status Register provides the user a mechanism for checking the status of GATE_H, GATE_M and GATE_L. These bits are volatile and are read only.

The gate status values in the Status Register can be read at any time by performing a random read operation. Only one byte is returned by each read operation. The master should supply a stop condition following the output byte to be consistent with the bus protocol.

STAT_GATEH: GATEH Status Flag (volatile)

STAT_GATEH will be set to ‘1’ when the GATE_H charge pump is turned on. It will be reset to ‘0’ when the GATE_H charge pump is turned off.

STAT_GATEM: GATEM Status Flag (volatile)

STAT_GATEM will be set to ‘1’ when GATE_M charge pump is turned on. It will be reset to ‘0’ when the GATE_M charge pump is turned off.

STAT_GATEL: GATEL Status Flag (volatile)

STAT_GATEL will be set to ‘1’ when GATE_L charge pump is turned on. It will be reset to ‘0’ when the GATE_L charge pump is turned off.

The status register also contains a WEL bit that controls write operations to the Shutdown Register. Bits 7, 6, 5, and 4 should always be set to ‘0’.

WEL: Write Enable Latch (Volatile)

The WEL bit controls the access to the Remote Shutdown Register (RSR). This bit is a volatile latch that powers up in the LOW (disabled) state. While the WEL bit is LOW, writes to the RSR will be ignored (no acknowledge will be issued after the Data Byte). The WEL bit is set by writing a "1" to the WEL bit and zeroes to the other bits of the status register.

Remote Shutdown Register (RSR) (Volatile)

RSR Data	Gate Shutdown	Sequence
01	GATE_M, GATE_L	GATE_M turns off, then after time t_{DELAY_DOWN} GATE_L turns off.
02	GATE_H	Immediate turn off of GATE_H
03	GATE_H, GATE_M, GATE_L	GATE_H and GATE_M turn off, then after time t_{DELAY_DOWN} GATE_L turns off.
00	no override	X80200 returns to previous condition, assuming all supplies are good, GATE_H and GATE_L turn on, then GATE_M turns on according to the chosen sequence mode.

The X80200 provides the user with a software shutdown of GATE_H, GATE_L and GATE_M. This overrides the normal output control.

A write operation with data 01h to the RSR will immediately turn off GATE_M followed by GATE_L. The GATE_L turn off is delayed by t_{DELAY_DOWN}.

A write operation with data 02 to the RSR will turn off GATE_H.

A write operation with data 03 to RSR will shutdown all gates. GATE_H turn off at the same time as GATE_M. GATE_L turns off after a delay of t_{DELAY_DOWN}.

A write operation with data 00h to the RSR will remove the software override function. Assuming all supplies are good, the X80200 will return to the previous state by first turning on GATE_H and GATE_L. Then, GATE_M is turned on according to the power sequencing mode chosen.

Bits 7, 6, 5, 4 and 3 of the Remote Shutdown Register should always be set to '0'.

The data in the RSR can be read by performing a random read operation to the RSR. The data in the RSR powers up in '0' state.

BUS INTERFACE INFORMATION

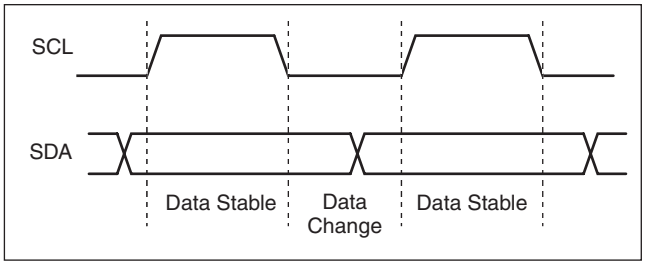
Interface Conventions

The device supports a bidirectional bus oriented protocol. The protocol defines any device that sends data onto the bus as a transmitter, and the receiving device as the receiver. The device controlling the transfer is called the master and the device being controlled is called the slave. The master always initiates data transfers, and provides the clock for both transmit and receive operations. Therefore, the devices in this family operate as slaves in all applications.

Serial Clock and Data

Data states on the SDA line can change only during SCL LOW. SDA state changes during SCL HIGH are reserved for indicating start and stop conditions. See Figure 7.

Figure 7. Valid Data Changes on the SDA Bus



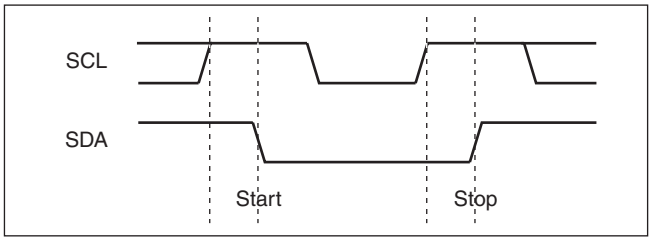
Serial Start Condition

All commands are preceded by the start condition, which is a HIGH to LOW transition of SDA when SCL is HIGH. The device continuously monitors the SDA and SCL lines for the start condition and will not respond to any command until this condition has been met. See Figure 8.

Serial Stop Condition

All communications must be terminated by a stop condition, which is a LOW to HIGH transition of SDA when SCL is HIGH. The stop condition is also used to place the device into the Standby power mode after a read sequence. A stop condition can only be issued after the transmitting device has released the bus. See Figure 8.

Figure 8. Valid Start and Stop Conditions



Slave Address Byte

Following a START condition, the master must output a Slave Address Byte. This byte consists of three parts:

– The Device Type Identifier which consists of the most significant four bits of the Slave Address. The Device Type Identifier MUST be set to 1010 in order to select the device.

– The next 3 bits (SA3 - SA1) are slave address bits. These bits are compared to the status of the input pins A2–A0.

– The Least Significant Bit of the Slave Address (SA0) Byte is the R/$\overline{W}$ bit. This bit defines the operation to be performed on the device being addressed (as defined in the bits SA2 - SA1). When the R/$\overline{W}$ bit is “1”, then a READ operation is selected. A “0” selects a WRITE operation.

Word Address

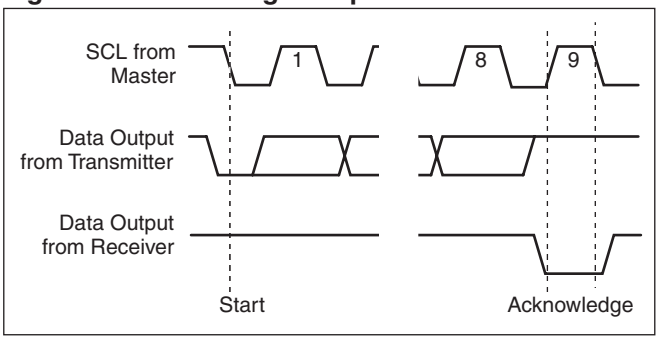
The next 8 bits following the slave byte, BA7–BA0, determine the portion of the device accessed. If all ‘0’s, then Status Register (SR) is selected. If all ‘1’s, then the Remote Shutdown Register (RSR) is selected.

Serial Acknowledge

Acknowledge is a software convention used to indicate successful data transfer. The transmitting device, either master or slave, will release the bus after transmitting eight bits. During the ninth clock cycle, the receiver will pull the SDA line LOW to acknowledge that it received the eight bits of data. See Figure 9.

The device will respond with an acknowledge after recognition of a start condition and if the correct Device Identifier and Select bits are contained in the Slave Address Byte. If a write operation is selected, the device will respond with an acknowledge after the receipt of each subsequent eight bit word. The device will acknowledge all incoming data and address bytes, except for the Slave Address Byte when the Device Identifier and/or Select bits are incorrect.

Figure 9. Acknowledge Response From Receiver



Write Operation

For a write operation, the device requires the Slave Address Byte and a Word Address Byte. This gives the master access to the registers. After receipt of the Word Address Byte, the device responds with an acknowledge, and awaits the next eight bits of data. After receiving the 8 bits of the Data Byte, the device again responds with an acknowledge. The master then terminates the transfer by generating a stop condition. See Figure 11. See Figure 1 for bus timing.

In order to perform a write operation to Remote Shutdown Register, the Write Enable Latch (WEL) bit must first be set.

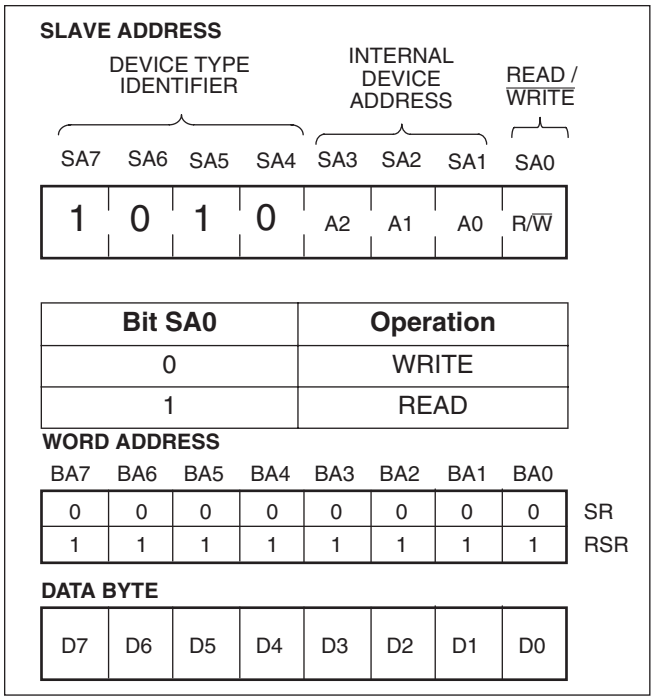
Read Operation

A Read operation is initiated in the same manner as a write operation with the exception that the R/$\overline{W}$ bit of the Slave Address Byte is set to one.

Prior to issuing the Slave Address Byte with the R/$\overline{W}$ bit set to one, the master must first perform a “dummy” write operation. The master issues the start condition and the Slave Address Byte, receives an acknowledge, then issues the Word Address Byte. After acknowledging receipt of the Word Address Byte, the master immediately issues another start condition and the Slave Address Byte with the R/$\overline{W}$ bit set to one. This is followed by an acknowledge from the device and then by the data byte containing the register contents. The master terminates the read operation by responding with a no-acknowledge and then issuing a stop condition. The ninth clock cycle of the read operation is not a “don’t care.” To terminate a read operation, the master must either issue a stop condition during the ninth cycle or hold SDA HIGH during the ninth clock cycle and then issue a stop condition.

See Figure 12 for the address, acknowledge, and data transfer sequence. See Figure 1 for bus timing.

Figure 10. Address Format



Operational Notes

The device powers-up in the following state:

– The device is in the low power standby state.

– The WEL bit is set to ‘0’. It is not possible to write to the device.

– The WEL bit must be set to allow write operations.

– SDA pin is the input mode.

– The data in the RSR powers up in ‘0’ state.

Figure 11. Byte Write Sequence

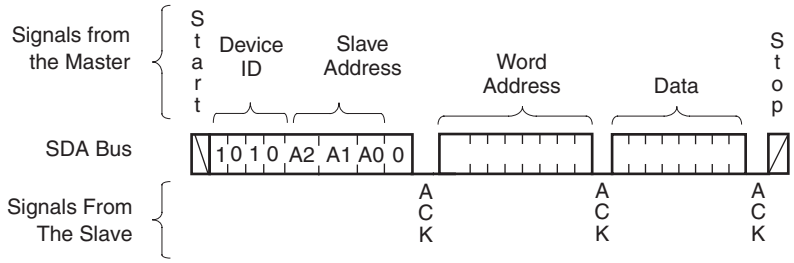
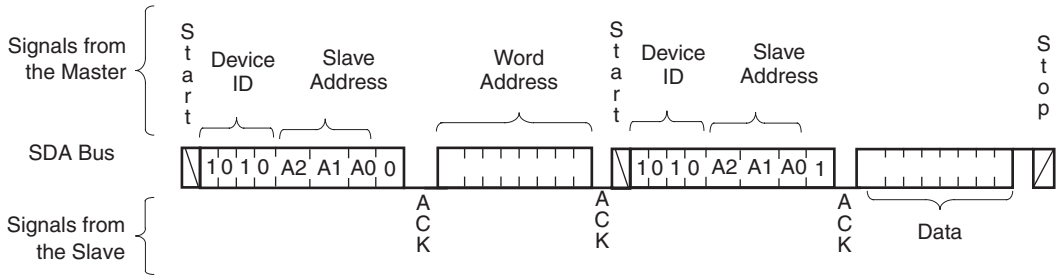


Figure 12. Read Sequence



APPLICATION SECTION

Figure 13. Telecom Backplace/System Power Supply Voltage Based Power Sequencing

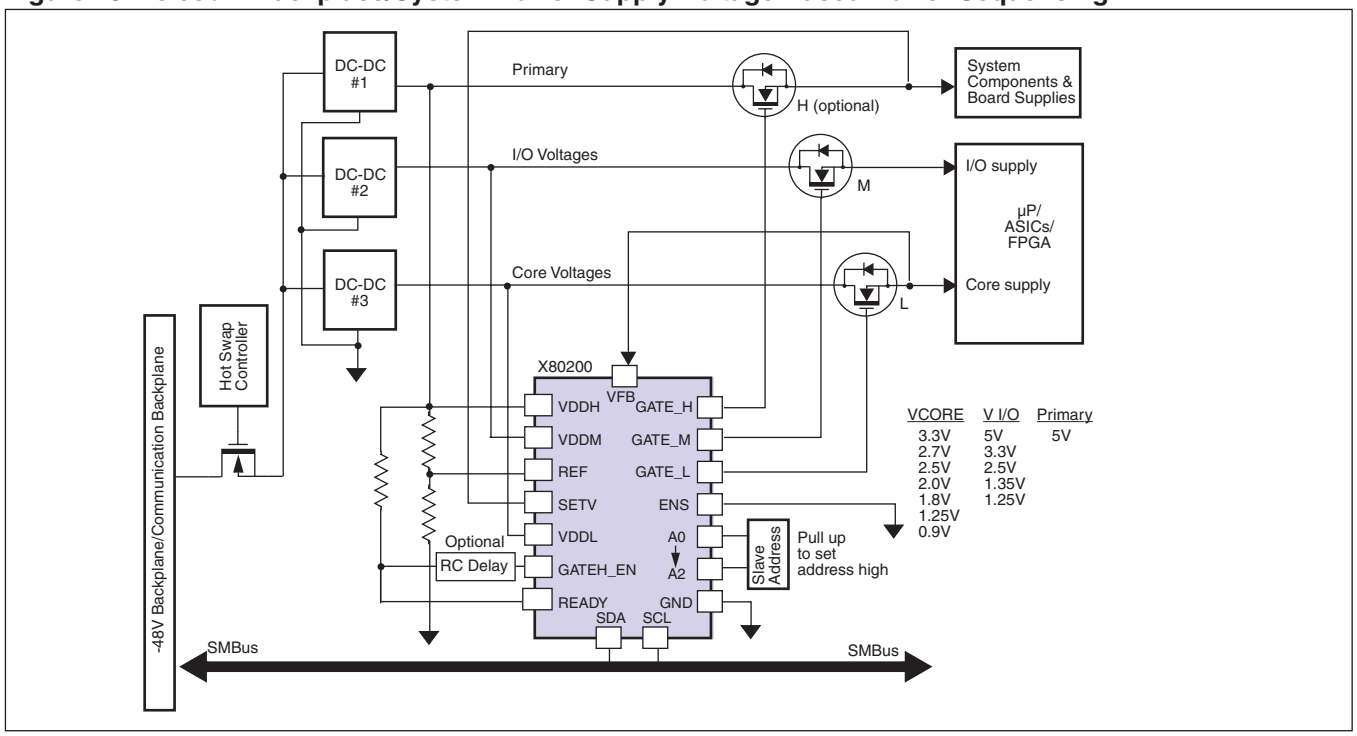


Figure 14. Telecom Backplace/System Power Supply Time Based Power Sequencing

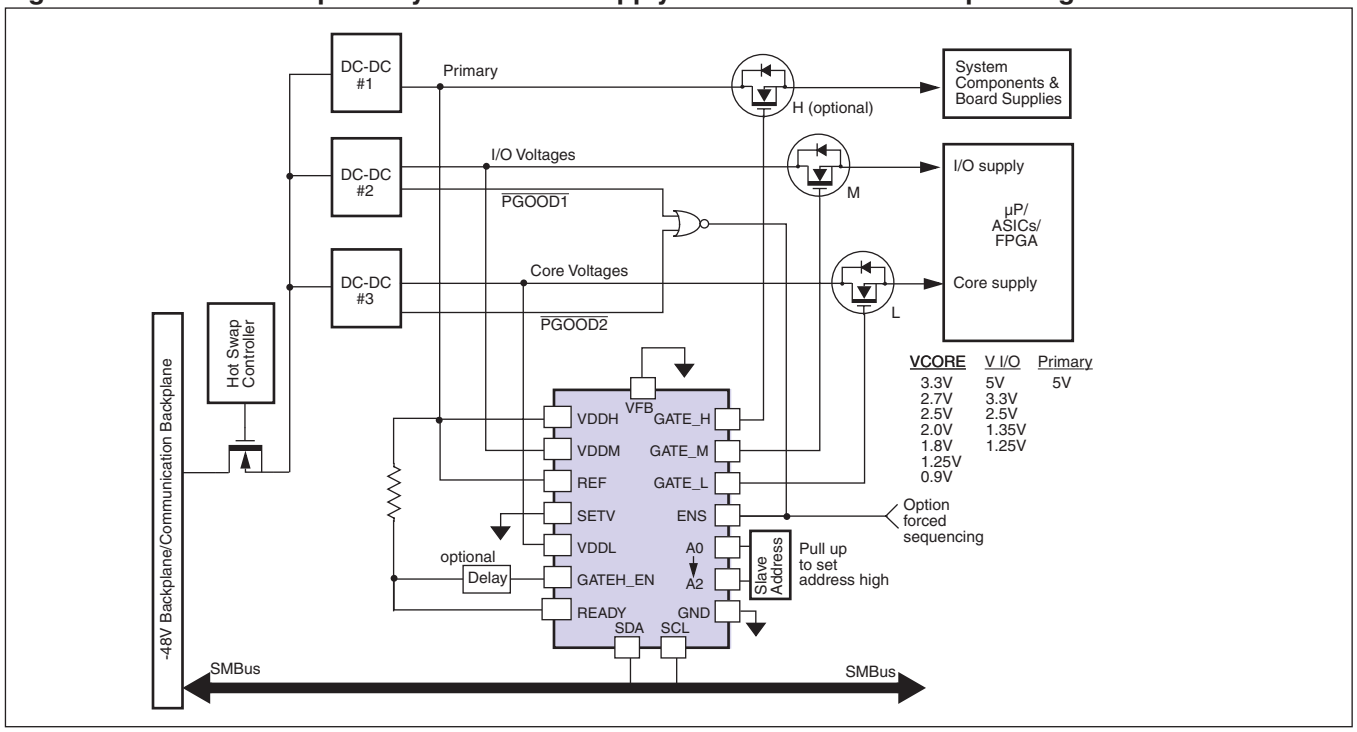
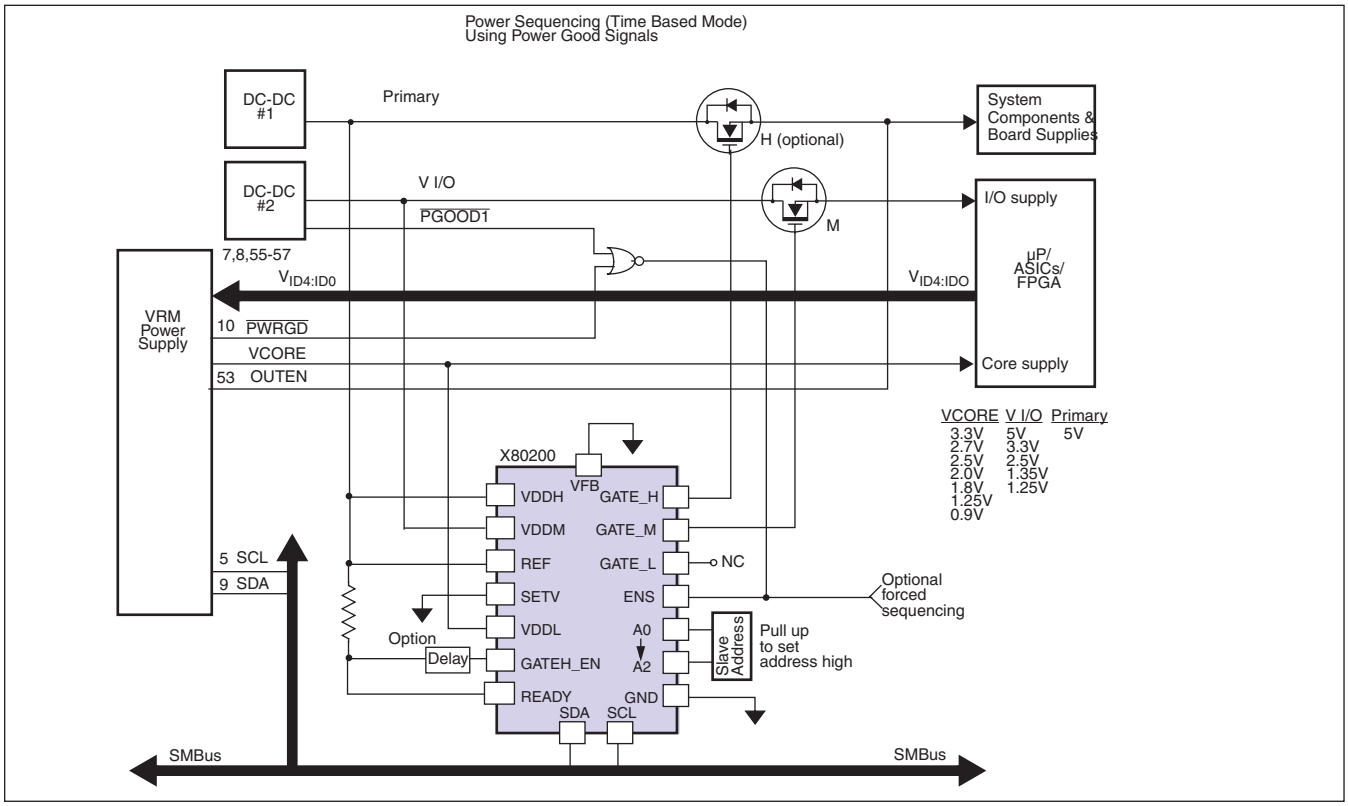
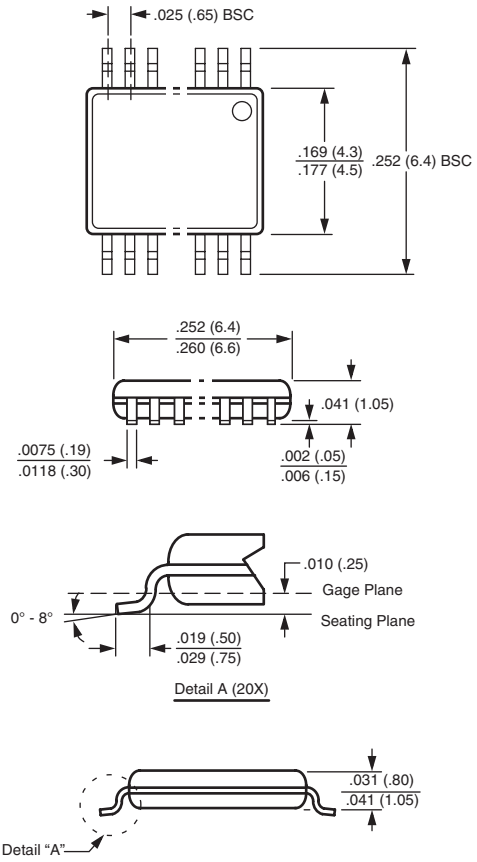


Figure 15. Power Sequencing of VRM Supplies



PACKAGING INFORMATION

20-Lead Plastic, TSSOP, Package Code V20



NOTE: ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)