Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

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General Description

The MAX20317 is an I²C controllable, universal 3.5mmØ accessory management IC. The device provides a universal jack interface solution, as well as a compact solution for the power management and interface control of a powered accessory, such as an active noise cancelling (ANC) headset.

The MAX20317 automatically measures headset impedance with a high precision, triple current source 8 bit ADC. After impedance detection, the device also detects when a headset is in a CTIA or OMTP configuration and automatically configures the SLEEVE and RING2 terminals to correctly connect the microphone and ground lines.

When a boost supply is applied, the MAX20317 can detect the presence of an ANC headset. When the ANC headset is detected and enabled, a button-press monitoring circuit activates and flags button presses by detecting the voltage drop across a sense resistor.

The MAX20317 provides a power line communication tool to a headset to exchange the data with the host device.

The MAX20317 has the two separate ground sense inputs from the SLEEVE and RING2 terminals of the connector to provide a high ground isolation to the audio codec.

The MAX20317 is available in a space-saving, 20-bump, 0.4mm pitch, 1.65mm x 2.05mm wafer-level package (WLP) and operates over the -40°C to +85°C extended temperature range.

Applications

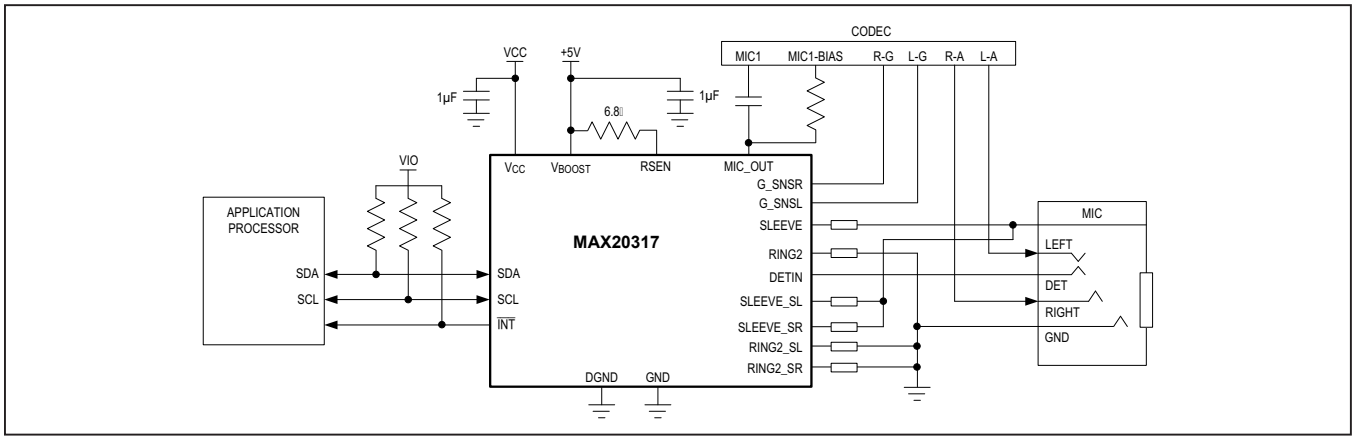
- Smart Phones
- Phablet
- Tablet PCs
- Notebook PCs

Benefits and Features

- Allows Wide Range of Applications by Supporting Universal 3.5mm Jack Types
  - Auto-Configuration for CTIA and OMTP Headsets
  - Supports MEMS Microphone
  - 50mΩ Ground Switch
- Enables Long Utilization of Accessories by Supplying Power Through 3.5mm Jack
  - Powered Accessory/Headset Detection
  - Bypass Switch to Power Accessories such as ANC Headsets
  - Programmable Button Detection in Powered Accessory Mode
- Empowers New Path in Data Communication to Accessories
  - Power Line Communication by 3.5mm Jack
  - Bidirectional Digital Data Communication in Power Mode
  - Allow Emergence of New Accessory Types
- Provides Comfortable Sounds by Introducing Automatic Volume Adjustment
  - Adaptive Volume Control Based on Precision Headset Impedance
  - False Insertion Detection
- Saves Board Space with Small Form Factor
  - 1.65mm x 2.05mm 4 x 5 Array 20 Bump 0.4mm Pitch WLP

***Ordering Information* appears at end of data sheet.**

Typical Application Circuit



Absolute Maximum Ratings

All voltages are referred to GND unless otherwise noted
V_{CC}, SCL, SDA, $\overline{INT}$ .....-0.3V to +6V
V_{BOOST}, RSEN .....-0.3V to +12V
MIC_OUT .....-0.3V to V_{CC} + 0.3V
DETIN.....-3V to V_{CC} + 0.3V
SLEEVE, SLEEVE_SL, SLEEVE_SR,
RING2, RING2_SL, RING2_SR .....-0.3V to +6V
G_SNSL, G_SNSR .....-0.3V to +0.3V
Continuous Current into V_{BOOST}, RSEN,
MIC_OUT, RING2, SLEEVE.....±200mA
Continuous Current into Any Other Terminal .....±100mA
Continuous Power Dissipation (Multilayer Board)
(Derate 18.02mW/°C above +70°C).....1441.6mW
Operating Temperature Range..... -40°C to +85°C
Junction Temperature.....+150°C
Storage Temperature Range..... -65°C to +150°C
Soldering Temperature (Reflow).....+260°C

Package Thermal Characteristics (Note 1)

WLP
Junction-to-Ambient Thermal Resistance,
Four Layer Board (θ_{JA}) .....55.49°C/W

Note 1: Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to **www.maximintegrated.com/thermal-tutorial**.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical Characteristics

(V_{CC} = +3.0V to +5.5V, V_{BOOST} = 0V to +5.5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.5V, T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
V_{CC}						
Supply Voltage Range	V_{CC}		3		5.5	V
V_{CC} POR	V_{CCPOR}		0.9	1.7	2.45	V
V_{CC} Supply Current	I_{VCC}	V_{CC} = +3.5V, DETIN = 1		2	5	µA
		BYPASS (0x08[2]) = 0, DETIN = 0		10	15	
		V_{CC} = +3.5V, BYPASS (0x08[2]) = 1, DETIN = 0, I_{VBOOST} = 30mA		0.1	0.2	mA
Bypass Supply Voltage Range	V_{BOOST}				5.5	V
DETIN						
DETIN Pullup Current	I_{DETIN_PU}			4.5		µA
DETIN Detection Threshold			1/3 x V_{CC}	1/2 x V_{CC}	2/3 x V_{CC}	V
DETIN Current Source	I_{DETIN}	SET_IDET (0x0B[5:4]) = 01	95	100	105	µA
		SET_IDET (0x0B[5:4]) = 10	1.05	1.1	1.15	mA
		SET_IDET (0x0B[5:4]) = 11	5.25	5.5	5.75	

Electrical Characteristics (continued)

(V_{CC} = +3.0V to +5.5V, V_{BOOST} = 0V to +5.5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.5V, T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
BYPASS SWITCH						
Output Shutdown R_{SEN} Drop	V_{SH}	V_{BOOST} = 5.0V	1.28	1.36	1.44	V
Bypass Switch R_{ON}	R_{BYPASS}	V_{CC} = 4.2V, V_{BOOST} = 5.0V, I_{BYPASS} = 150mA		1	1.5	Ω
Off Isolation to SLEEVE		V_{RSEN} = 5V ± 50mV, f = 20Hz to 20kHz		-90		dB
SLEEVE, RING2 (GND MUX SWITCH)						
Ground MUX Switch R_{ON}	R_{GMP}	V_{CC} = 3.5V		50	85	mΩ
Ground MUX Switch Bandwidth		R_{SOURCE} = R_{LOAD} = 50Ω		300		MHz
Ground Switch PSRR	$PSRR_{GNDSW}$	V_{CC} = 3.5V, R_{SOURCE} = 50Ω, f = 217Hz		-96		dB
Ground Bypass Switch THD		100mV_{Pk-Pk}, DC bias = 0V, f = 20Hz to 20KHz, R_{SOURCE} = R_{LOAD} = 50Ω		0.002		%
SLEEVE, RING2 (MIC MUX SWITCH)						
MIC Switch Turn-On Time				5		µs
MIC Switch Turn-Off Time				4		µs
MIC Switch R_{ON}	R_{MIC}	V_{CC} = 3.5V, I = 10mA		1	2	Ω
MIC Switch Bandwidth		R_{SOURCE} = R_{LOAD} = 50Ω		25		MHz
MIC Switch PSRR		V_{CC} = 3.5V, R_{SOURCE} = 50Ω, f = 217Hz		-90		dB
MIC Switch Isolation				-90		dB
V_{BOOST}, RSEN (ANC DETECTION)						
ANC Headset Detection Accuracy		Using 6.8Ω External Sense for ANC detection, range from 1.5 to 5mA (ADC2_HL(0x0B[2])) = 1. Thresholds I^2C Programmable by HSDET_VAL	-3		+3	%
Button Press Current Measurement Accuracy		Using 6.8Ω External Sense, range from 5mA to 200mA (ADC2_HL(0x0B[2])) = 0. Thresholds I^2C Programmable by HSDET_VAL	-3		+3	%
ANC Button Detection Interrupt Falling Edge Threshold	V_{COM_DET}	COM_THRS[1:0](0x08[1:0]) = 00	87	88	89	%V_{BOOST}
		COM_THRS[1:0] (0x08[1:0]) = 01	89	90	91	%V_{BOOST}
		COM_THRS[1:0] (0x08[1:0]) = 10	91	92	93	%V_{BOOST}
		COM_THRS[1:0] (0x08[1:0]) = 11	93	94	95	%V_{BOOST}
BOOST OVP OVLO Threshold	V_{BOOST_OVLO}	V_{BOOST} slew rate ≤ 1V/µs	5.6	5.75	5.94	V

Electrical Characteristics (continued)

(V_{CC} = +3.0V to +5.5V, V_{BOOST} = 0V to +5.5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.5V, T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
GROUND SENSE SWITCH (G_SNSR/G_SNSL)						
G_SNS Switch Turn-On Time				50		µs
G_SNS Switch Turn-Off Time				3		µs
G_SNS Switch R_{ON}		I_{LOAD} = 10mA		0.8	1.5	Ω
G_SNS Switch Bandwidth		R_{SOURCE} = R_{LOAD} = 50Ω, C_{LOAD} = 10pF		300		MHz
G_SNS Switch PSRR		V_{CC} = 3.3V, R_{SOURCE} = R_{LOAD} = 50Ω, f = 217Hz, V_{IN} = 3.3V ±0.1V		-90		dB
G_SNS Switch Cross talk		V_{CC} = 3.3V, R_{SOURCE} = R_{LOAD} = 50Ω, f = 20Hz to 20kHz, V_{MIC} = ±150mV		-90		dB
DIGITAL SIGNALS (SDA, SCL, $\overline{INT}$)						
Input Logic-High	V_{IH}		1.4			V
Input Logic-Low	V_{IL}				0.4	V
Input Leakage Current			-1		1	µA
Output Logic-High Leakage Current (Open-Drain)	I_{OH_LKG}	V_{IO} = 5V			1	µA
Output Logic-Low	V_{OL}	I_{SINK} = 4mA			0.4	V
POWER LINE COMMUNICATION						
PLC Logic-High		V_{BOOST} = 5V, Low is V_{RSENSE} below V_{COM_DET}			V_{COM_DET}	V
PLC Logic-Low		V_{BOOST} = 5V, High is V_{RSENSE} above V_{COM_DET}	V_{COM_DET}			V
Time Unit	t_{UNIT}	I^2C Programmable (24/30µs) Inferred from 1µs clock		24/30		µs
TX Logic 0	$t_{TXLOGIC0}$		90		110	% t_{UNIT}
TX Logic 1	$t_{TXLOGIC1}$	Period for low and high	40		60	% t_{UNIT}
RX Logic 0	$t_{RXLOGIC0}$		85		115	% t_{UNIT}
RX Logic 1	$t_{RXLOGIC1}$	Period for low and high	35		65	% t_{UNIT}
PLC TX Current Sink	I_{PLC}	PLC_SINK (0x18[6]) = 0	90	100	110	mA
		PLC_SINK(0x18[6]) = 1	70	80	90	mA

Electrical Characteristics (continued)

(V_{CC} = +3.0V to +5.5V, V_{BOOST} = 0V to +5.5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.5V, T_A = +25°C.) (Note 2)

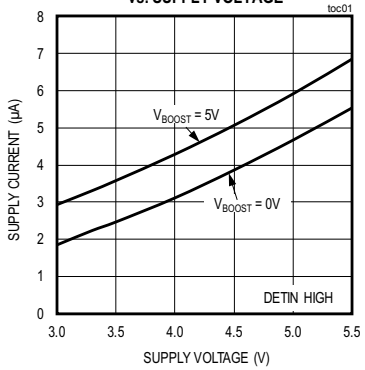
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DYNAMIC						
DETIN Debounce Time	t_{DIDEB}	DETIN Falling Edge, DET_DEBOUNCE (0x08[6]) = 0		115		ms
		DETIN Falling Edge, DET_DEBOUNCE (0x08[6]) = 1		300		
SEND/END Debounce Time	t_{SEDEB}	I²C selectable: 20/30/40/50ms		30		ms
I_{DETIN} Rise Time	$t_{IDETINR}$	Rising		50		ms
I_{DETIN} Fall Time	$t_{IDETINF}$	Falling		50		ms
I²C TIMING						
I²C Serial Clock Frequency	f_{SCL}			400		kHz
ESD PROTECTION						
DETIN		Human Body Model		±15		kV
SLEEVE, RING2, SLEEVE_SR, SLEEVE_SL, RING2_SR, RING2_SL		Human Body Model		±10		kV
All Other Pins		Human Body Model		±2		kV
THERMAL PROTECTION						
Thermal Shutdown	T_{SHDN}	Low to high		130		°C
Thermal Hysteresis	T_{HYST}	High to low		20		°C

Note 2: All devices are 100% production tested at T_A = +25°C. Limits over the operating temperature range are guaranteed by design.

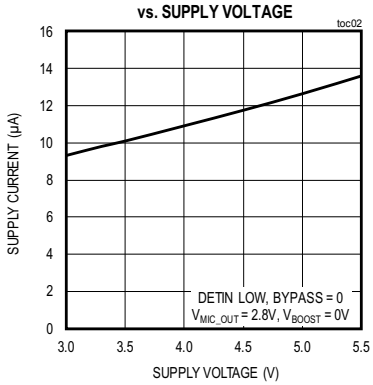
Typical Operating Characteristics

(V_{CC} = +3.5V, R_{SEN} = 6.8Ω, T_A = +25°C unless otherwise noted.)

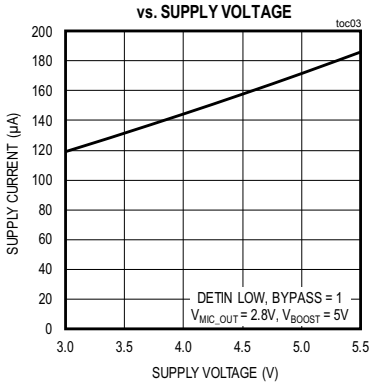
SUPPLY CURRENT vs. SUPPLY VOLTAGE



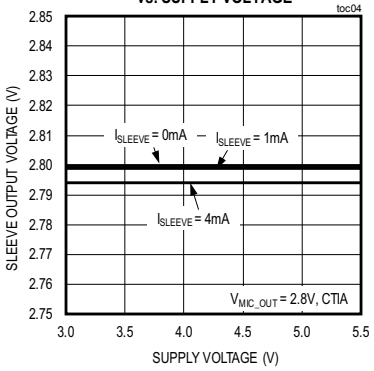
SUPPLY CURRENT vs. SUPPLY VOLTAGE



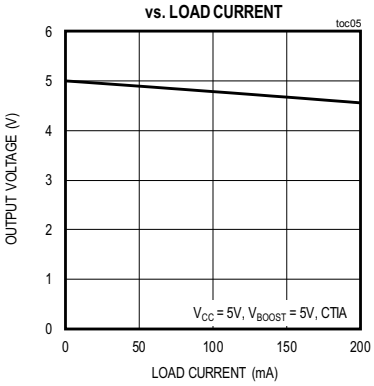
SUPPLY CURRENT vs. SUPPLY VOLTAGE



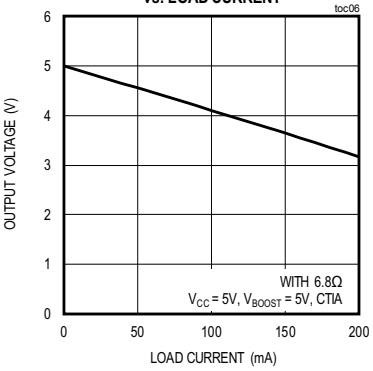
SLEEVE OUTPUT VOLTAGE vs. SUPPLY VOLTAGE



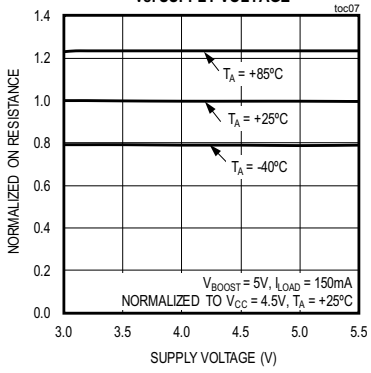
BYPASS SWITCH OUTPUT VOLTAGE vs. LOAD CURRENT



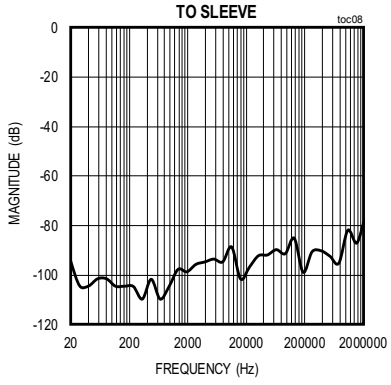
BYPASS SWITCH OUTPUT VOLTAGE vs. LOAD CURRENT



BYPASS SWITCH NORMALIZED ON-RESISTANCE vs. SUPPLY VOLTAGE



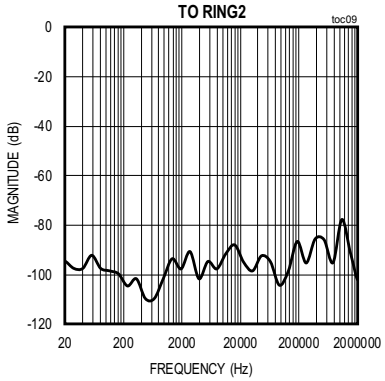
BYPASS SWITCH OFF-ISOLATION TO SLEEVE



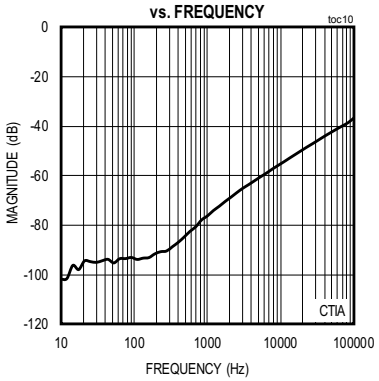
Typical Operating Characteristics (continued)

(V_{CC} = +3.5V, R_{SEN} = 6.8Ω, T_A = +25°C unless otherwise noted.)

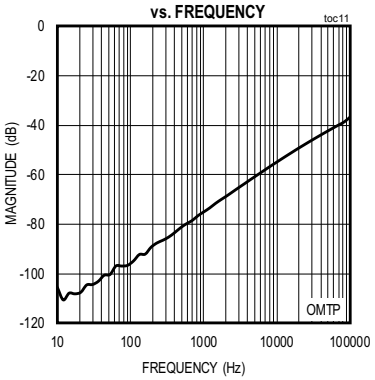
BYPASS SWITCH OFF-ISOLATION TO RING2



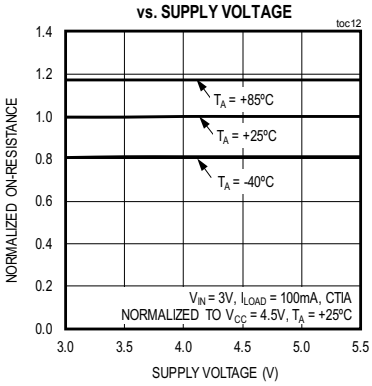
MIC MUX PSRR vs. FREQUENCY



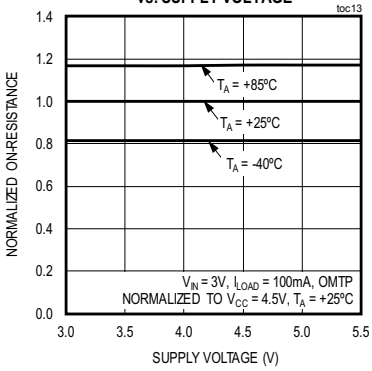
MIC MUX PSRR vs. FREQUENCY



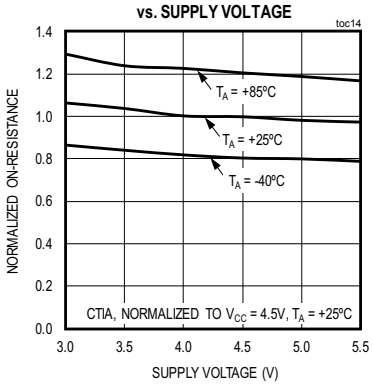
MIC MUX NORMALIZED ON-RESISTANCE vs. SUPPLY VOLTAGE



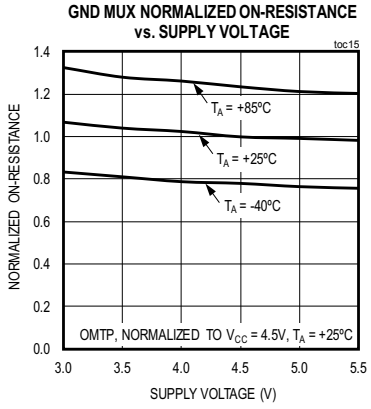
MIC MUX NORMALIZED ON-RESISTANCE vs. SUPPLY VOLTAGE



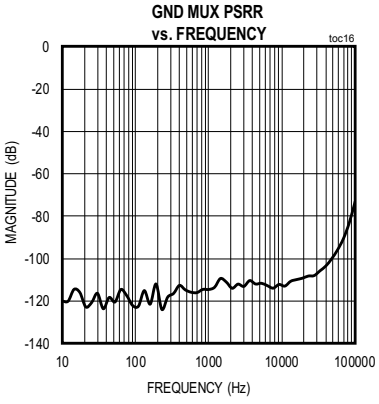
GND MUX NORMALIZED ON-RESISTANCE vs. SUPPLY VOLTAGE



GND MUX NORMALIZED ON-RESISTANCE vs. SUPPLY VOLTAGE



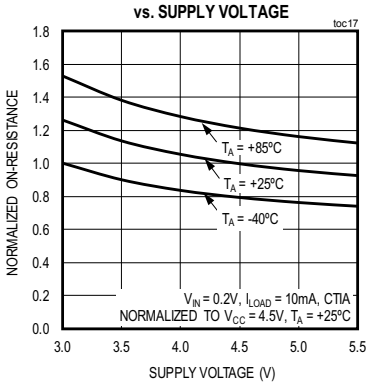
GND MUX PSRR vs. FREQUENCY



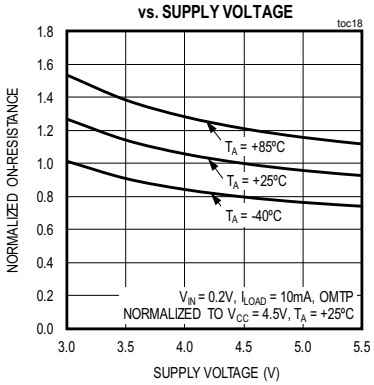
Typical Operating Characteristics (continued)

(V_{CC} = +3.5V, R_{SEN} = 6.8Ω, T_A = +25°C unless otherwise noted.)

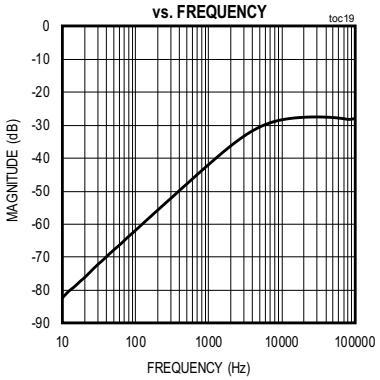
GND SENSE NORMALIZED ON-RESISTANCE vs. SUPPLY VOLTAGE



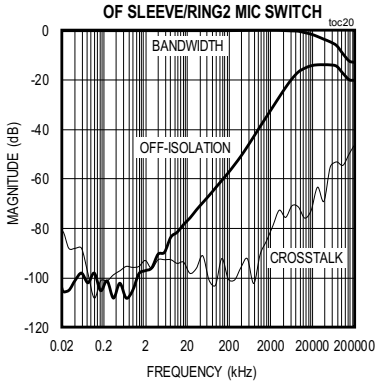
GND SENSE NORMALIZED ON-RESISTANCE vs. SUPPLY VOLTAGE



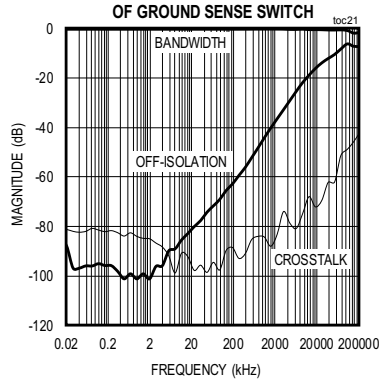
GND SENSE PSRR vs. FREQUENCY



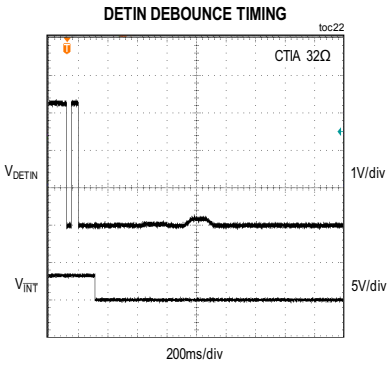
BANDWIDTH, OFF-ISOLATION, CROSSTALK OF SLEEVE/RING2 MIC SWITCH



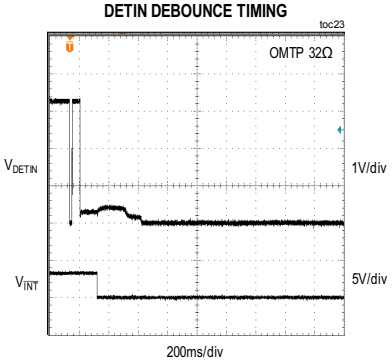
BANDWIDTH, OFF-ISOLATION, CROSSTALK OF GROUND SENSE SWITCH



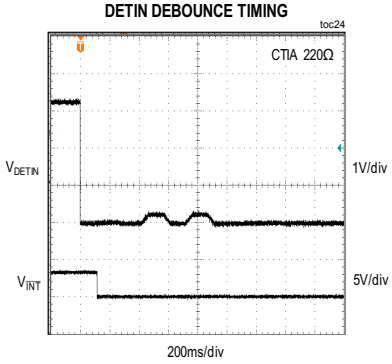
DETIN DEBOUNCE TIMING



DETIN DEBOUNCE TIMING



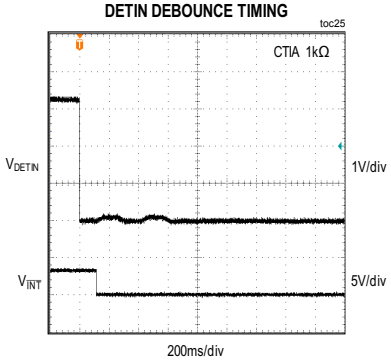
DETIN DEBOUNCE TIMING



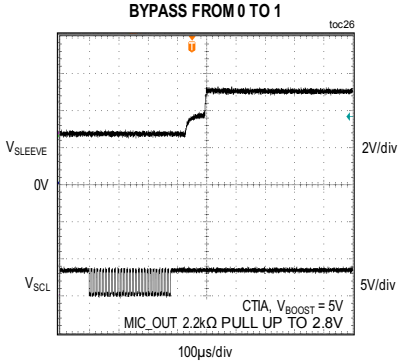
Typical Operating Characteristics (continued)

(V_{CC} = +3.5V, R_{SEN} = 6.8Ω, T_A = +25°C unless otherwise noted.)

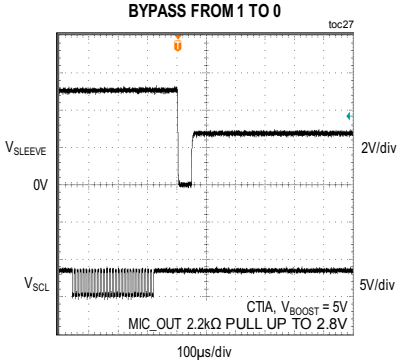
DETIN DEBOUNCE TIMING



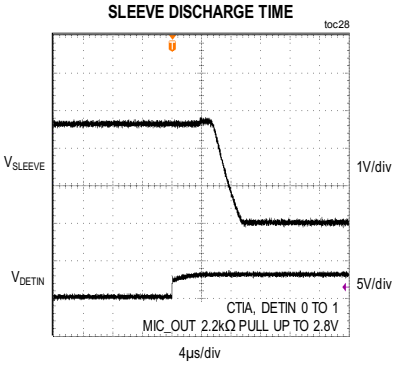
SLEEVE WAVEFORM BYPASS FROM 0 TO 1



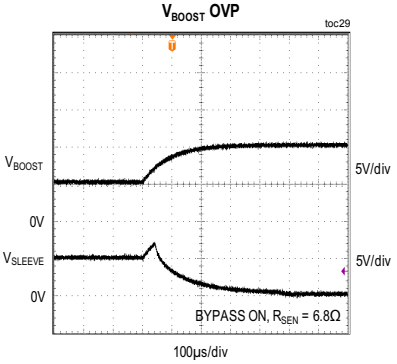
SLEEVE WAVEFORM BYPASS FROM 1 TO 0



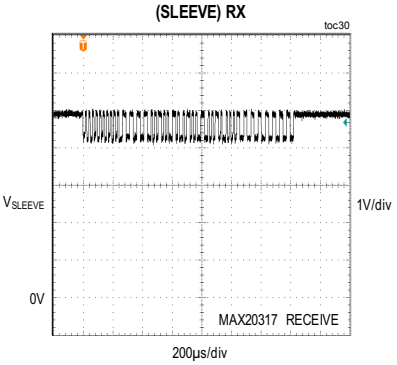
SLEEVE DISCHARGE TIME



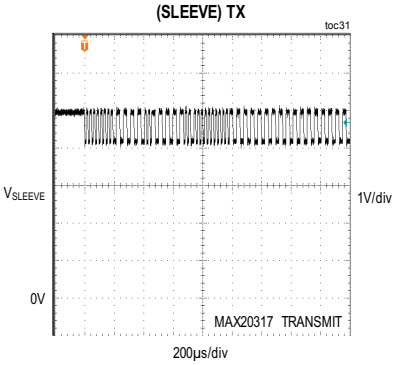
VBOOST OVP



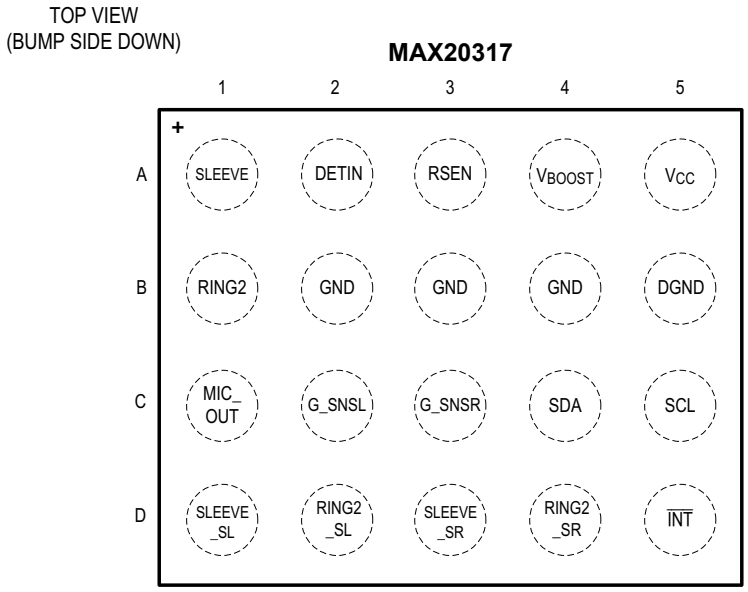
PLC COMMUNICATION (SLEEVE) RX



PLC COMMUNICATION (SLEEVE) TX



Bump Configuration



WLP
(2.05mm x 1.65mm)

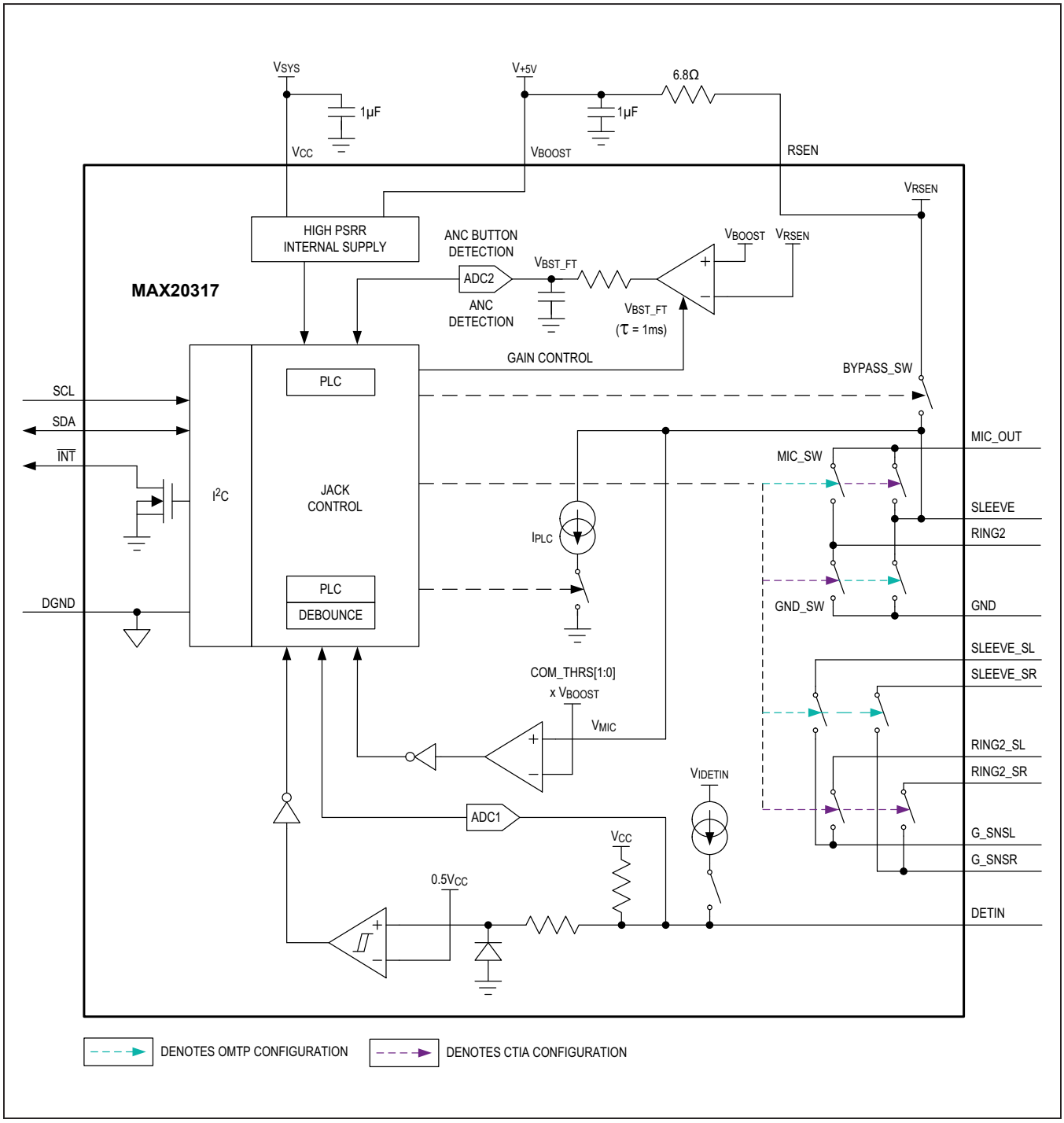
Bump Descriptions

BUMP	NAME	FUNCTION
A1	SLEEVE	Jack Sleeve Pin Contact
A2	DETIN	Jack Insertion Detection Input. An internal comparator monitors DETIN for jack insertion/ removal events.
A3	RSEN	RSEN connection for Bypass mode
A4	V_{BOOST}	Supply Voltage Input for Bypass Mode. Bypass V_{BOOST} to ground with a 1µF ceramic capacitor as close as possible to the device.
A5	V_{CC}	Supply Voltage Input. Bypass V_{CC} to ground with a 1µF decoupling capacitor as close as possible to the device.

Bump Descriptions (continued)

BUMP	NAME	FUNCTION
B1	RING2	Jack Ring2 Pin Connection
B2, B3, B4	GND	Ground. Connect all GND and DGND pins together.
B5	DGND	Digital Ground. Connect all GND and DGND pins together.
C1	MIC_OUT	Microphone to Phone Codec Output
C2	G_SNSL	Left Ground Reference Sense. G_SNSL is a ground reference prior to the ground switch to obtain a high ground isolation for the audio codec.
C3	G_SNSR	Right Ground Reference Sense. G_SNSL is a ground reference prior to the ground switch to obtain a high ground isolation for the audio codec.
C4	SDA	I^2C Data Line
C5	SCL	I^2C Clock
D1	SLEEVE_SL	Jack Sleeve Kelvin Pin Contact for Left Audio Line
D2	RING2_SL	Jack Ring2 Kelvin Pin Contact for Left Audio Line
D3	SLEEVE_SR	Jack Sleeve Kelvin Pin Contact for Right Audio Line
D4	RING2_SR	Jack Ring2 Kelvin Pin Contact for Right Audio Line
D5	$\overline{INT}$	I^2C Active-Low, Open-Drain Interrupt Output. Connect $\overline{INT}$ to an external pullup resistor.

Block Diagram



Detailed Description

The MAX20317 supports both CTIA and OMTP headsets. The advanced method used to detect the headset type provides error free connections to ground and the microphone line. Manual control allows for future expansion of accessory types and functions.

In addition to detecting the jack configuration, the MAX20317 also reliably detects ANC headsets and headset button press events. A built-in, low offset 8-bit ADC provides a precise method of detecting an ANC headset and button presses in ANC music mode. These functions are handled automatically by the device, but can also be controlled manually.

For both ANC and normal headsets, the MAX20317 measures the impedance of the speaker. High precision current sources and an 8-bit ADC permit high accuracy sensing of low impedance headsets, even distinguishing between 16Ω and 32Ω speakers. This is useful in dynamic volume scaling applications.

The MAX20317 features power-line communication (PLC) for accessories powered by the microphone line. Data transmits above audio frequencies to prevent interference with the audio signal to the headset. This permits accessories to communicate with the device while a system is in music mode.

After the startup process is complete and the DEVICE_READY bit (0x03[2]) is set, the MAX20317 enters normal operation. During this stage, an external controller and CODEC can confirm the jack type, either 3P or 4P, to enable or disable a MIC bias, detect the presence of an ANC headset, and communicate with accessories or use the headset microphone. The full system flowchart is shown in Figure 1, while Figure 2 details the jack detection process when a headset is connected.

Impedance Detection

When the MAX20317 detects the presence of a headset, it can measure the headset impedance. DETIN applies a current, I_{DETIN}, to the left channel of the 3.5mm jack and reads the resulting DC voltage with ADC1. This measurement occurs automatically when DET goes low after a DETIN debounce period or triggers manually upon receipt of an I^2C command while DET = 0. The start condition is set with ADC_CTRL[1:0] (0x0A[3:2]).

Automatic impedance measurements begin when a headset insertion event forces DET low. The MIC and GND switches close in a CTIA configuration. If the OPEN_DETECT bit (0x09[4]) is HIGH, I_{DETIN} is set to 100µA for a high-impedance measurement. If the voltage measured by ADC1 is less than the value saved in HIHS_VAL (register 0x0E), or if OPEN_DETECT is low, a low impedance measurement is performed with I_{DETIN} = 1.1mA. If the voltage is still too low, the low-impedance measurement is repeated with I_{DETIN} = 5.5mA. This automatic process is illustrated in Figure 3.

Alternatively, the MAX20317 can measure impedance only upon receipt of an I^2C command. Setting ADC1_CTRL[1:0] to 01 or 10 causes the impedance measurement to trigger when FORCE_ADC1_START (0x0B[1]) goes high. The I_{DETIN} value for manual impedance measurements is set by SET_IDET[1:0] (0x0B[5:4]). After an automatic measurement, SET_IDET[1:0] equals the last I_{DETIN} value used in the impedance check, but it can be forced to any value for manual tests.

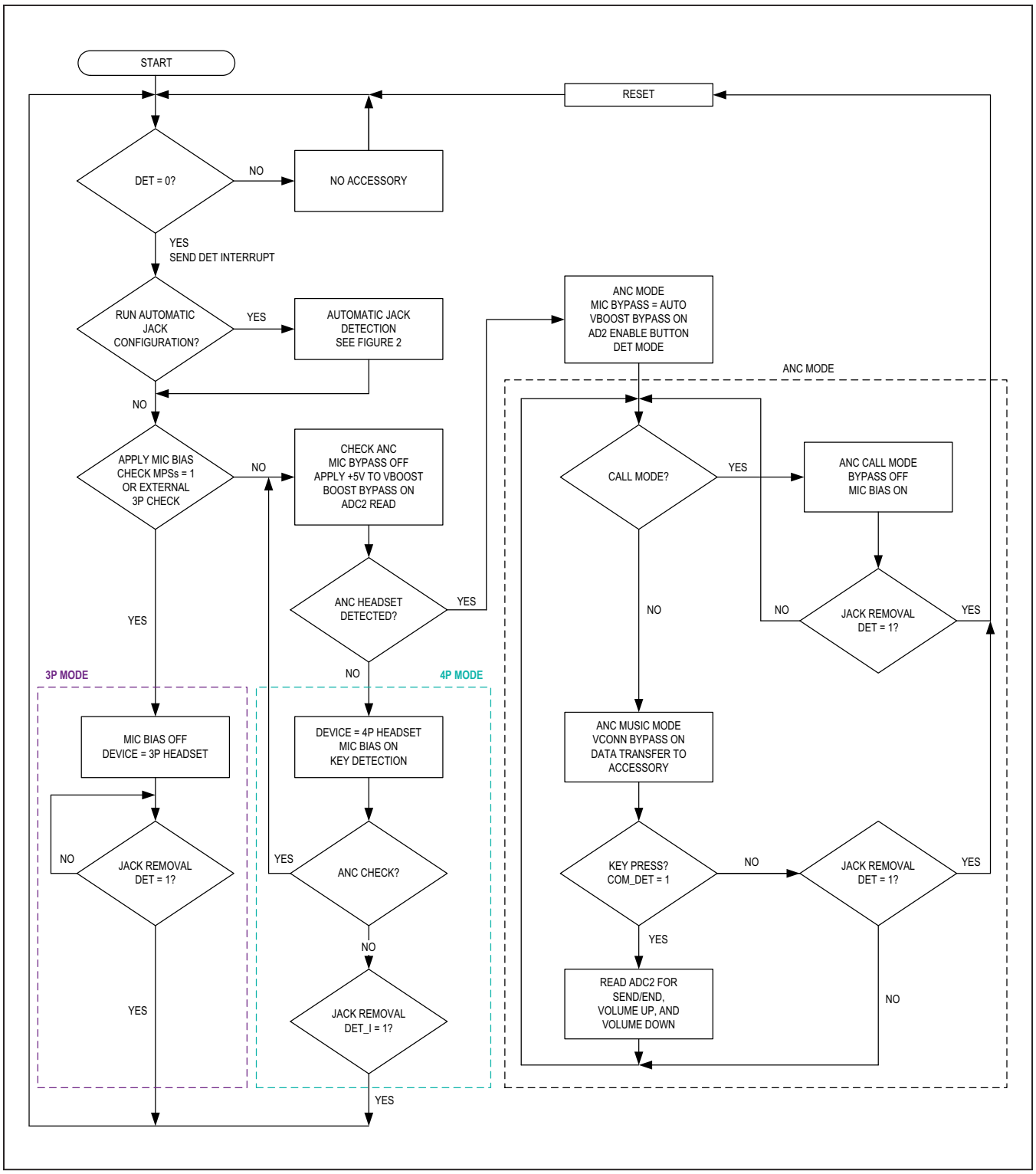


Figure 1. Full operation of the MAX20317

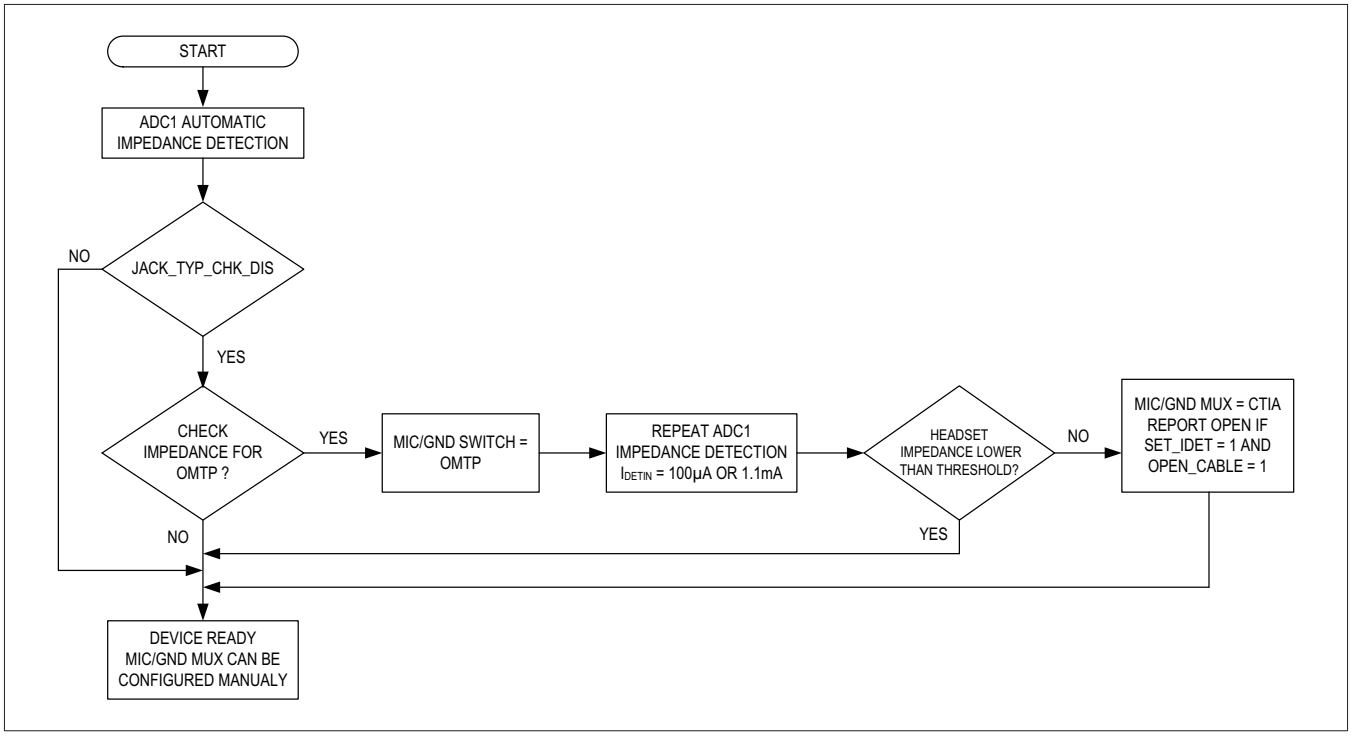


Figure 2. Automatic Jack Detection

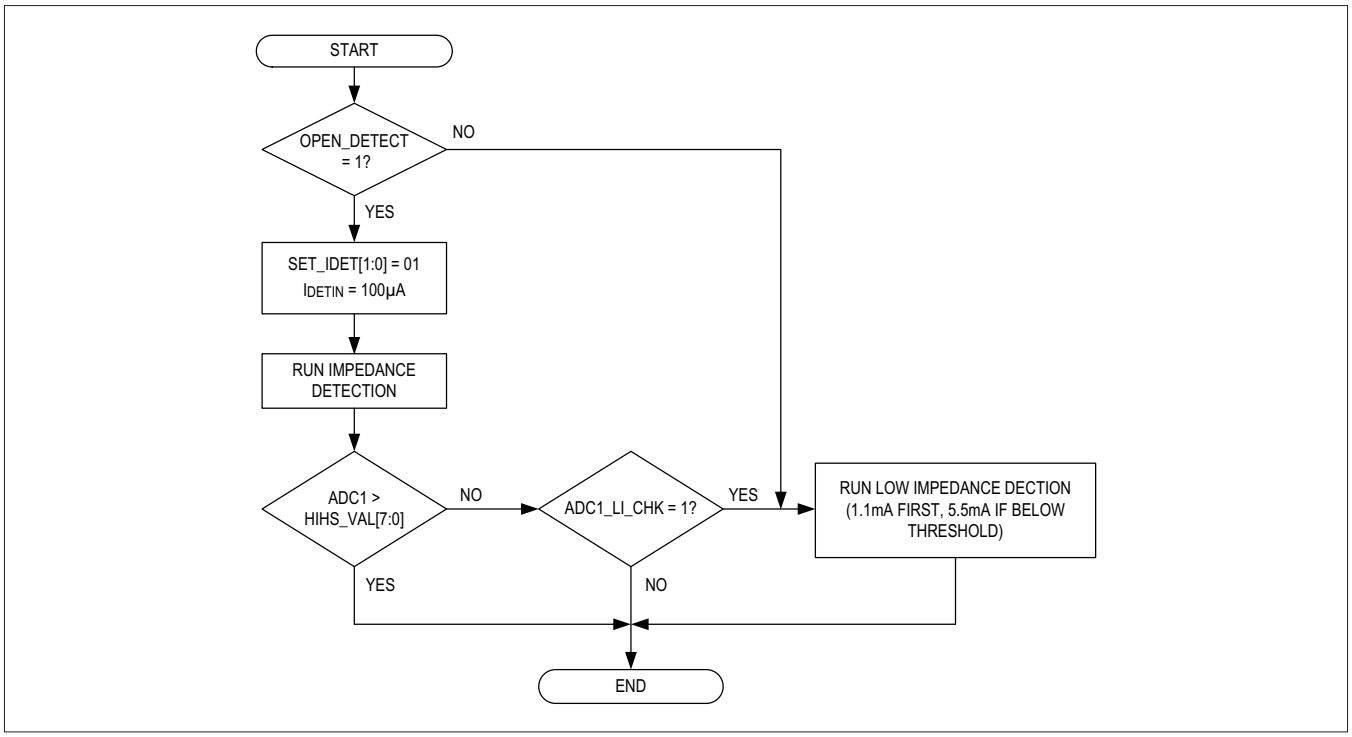


Figure 3. ADC1 Automatic Impedance Detection

CTIA/OMTP Detection

The impedance measurement process is also used to identify a jack as CTIA or OMTP. When JACK_TYP_CHK_DIS = 0 (0x0A[6]), CTIA/OMTP detection begins after an automatic impedance measurement. This second measurement keeps the last value of I_{DETIN}, either 100µA or 1.1mA, and measures the L-channel impedance with the MIC and GND MUX switches closed in OMTP mode. If the voltage measured by ADC1 is less than the threshold defined in OMTP_VAL (register 0x0F) when testing a low-impedance headset, or HIHS_VAL for high-impedance headsets, the MIC and GND MUX switches remain configured for OMTP. Otherwise, the switches connect in the CTIA configuration. Automatic jack detection is disabled when ADC1 is controlled manually or when JACK_TYP_CHK_DIS = 1 and the MIC and GND switches must be set by FORCE_MG_SW[1:0] (0x09[1:0]) and MANUAL_MG_SW (0x09[5]).

Open Cable Check

If OPEN_DETECT = 1 (0x09[4], the MAX20317 performs an open cable check after determining the jack type. If a high-impedance measurement exceeds the HIHS_VAL threshold, the cable is considered open and the OPEN_CABLE flag (0x03[4]) is set. This feature helps ensure that a there is a clean connection to a real headset when DET goes LOW after the DETIN debounce period.

ANC Headset Detection

The MAX20317 identifies ANC headsets by measuring the current drawn through an external resistor connected to RSEN. If there is +5V present on V_{BOOST}, an automatic measurement launches when the bypass switch closes. An internal, high-gain differential amplifier measures the current through the sense resistor and is read by ADC2. If the current is higher than HSDET_VAL (register 0x10), the headset is considered to be ANC and the ANC_HS bit (0x05[7]) is set. ANC headset detection is only compatible with CTIA headsets.

ANC Current Sense

The MAX20317 automatically detects ANC button presses while in BYPASS mode through the current sense resistor. When a button is pressed, the microphone voltage drops, triggering a COM_DET interrupt. This also triggers an automatic ADC2 conversion. The ADC2 conversion continues as long as the microphone voltage is below the COM_DET threshold set by COM_THRS[1:0] (0x08[1:0]).

Pop-Up Noise Suppression

In order to prevent any pop-up noise, SLEEVE and RING2 are discharged immediately after a headset is unplugged.

Microphone Short Protection

Overcurrent protection on RSEN protects the MAX20317 from drawing too much current through the sense resistor. When the voltage drop across the sense resistor exceeds V_{SH} for longer than the time set in tSHO_DEB[1:0] (0x0D[1:0]), the MPSs bit (0x04[4]) is set and triggers an interrupt. The MAX20317 exits bypass mode and resets BYPASS to “0.” The device also exits bypass mode if an overvoltage condition occurs on V_{BOOST}.

Power Line Communication

A one-wire accessory Power-Line-Communication Protocol (PLC) enables communication between a master device and a single accessory device over the microphone power line. The protocol allows the master to configure, control, and read the status of the attached accessory. When the accessory is powered, power line communication takes place over the microphone using biphase mark code (BMC).

The PLC can be implemented on any single power line between two devices. Error checking, including parity and checksum, is included in the protocol to validate all data transferred between devices. The protocol is defined by a physical layer, which describes the physical communication protocol, and the logical layer that includes high-level commands and handshakes. Figure 4 and Figure 5 show the process of sending and receiving PLC data, respectively. The MAX20317 supports physical data transfer between the master device and slave accessory. The meaning of the data contained in each individual accessory must be defined by the manufacturer of the master device.

SLEEVE and RING2 Ground Sense

Because audio systems require high levels of isolation between audio channels, the MAX20317 incorporates separate ground sense connections for SLEEVE and RING2. These ground sense contacts provide channel isolation with a Kelvin contact, especially when an EMC filter is included between the 3.5mm jack and the MAX20317. Individual left- and right-channel ground sense outputs provide separate return paths for SLEEVE and RING2.

I²C Interface

The MAX20317 uses the two-wire I²C interface to communicate with a host application processor. The configuration settings and status information provided through this interface are detailed in the register descriptions (Tables 2 – 31). MAX20317 uses the seven-bit slave address 0b0010101 (0x2A for writes, 0x2B for reads).

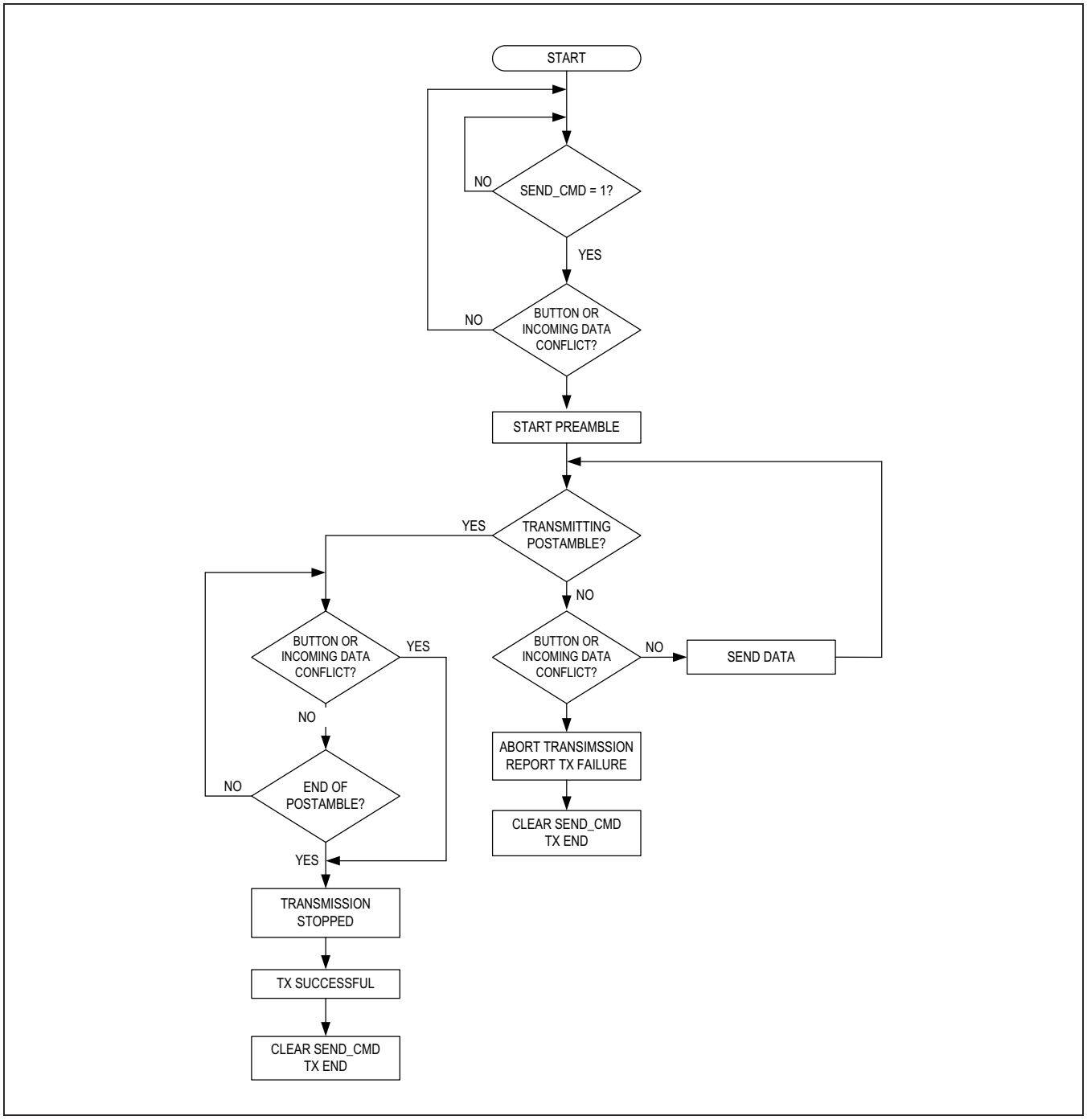


Figure 4. PLC TX Process

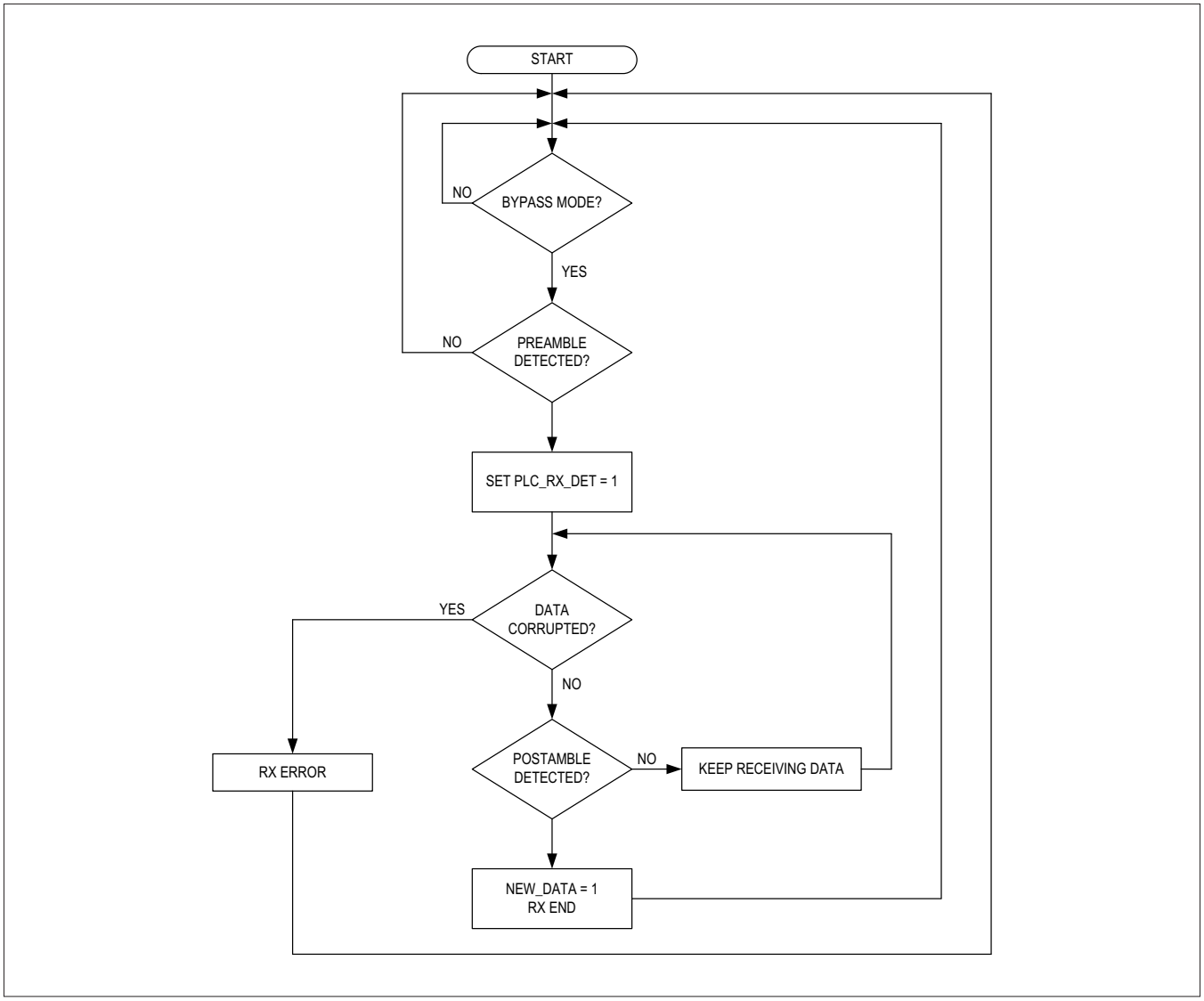


Figure 5. PLC RX Process

Applications Information

I²C Serial Interface

The I²C serial interface is used to configure the device. Figure 6 shows the I²C timing diagram.

Serial Addressing

When in I²C mode, the device operates as a slave device that sends and receives data through an I²C-compatible 2-wire interface. The interface uses a serial data line (SDA) and a serial-clock line (SCL) to achieve bidirectional communication between master(s) and slave(s). A master (typically a microcontroller) initiates all data transfers to and from the MAX20317 and generates the SCL clock that synchronizes the data transfer. The SDA line operates as both an input and an open drain output. A pullup resistor is required on SDA. The SCL line operates only as an input. A pullup resistor is required on SCL if there are multiple masters on the 2-wire interface, or if the master in a single-master system has an open drain SCL output. Each transmission consists of a START condition sent by a master, followed by the MAX20317 7-bit slave address plus R/W bit, a register address byte, one or more data bytes, and finally a STOP condition.

Start and Stop Conditions

Both SCL and SDA remain high when the interface is not busy. A master signals the beginning of a transmission with a START (S) condition by transitioning SDA from high to low while SCL is high (Figure 7). When the master has finished communicating with the slave, it issues a STOP (P) condition by transitioning SDA from low to high while SCL is high. The bus is then free for another transmission.

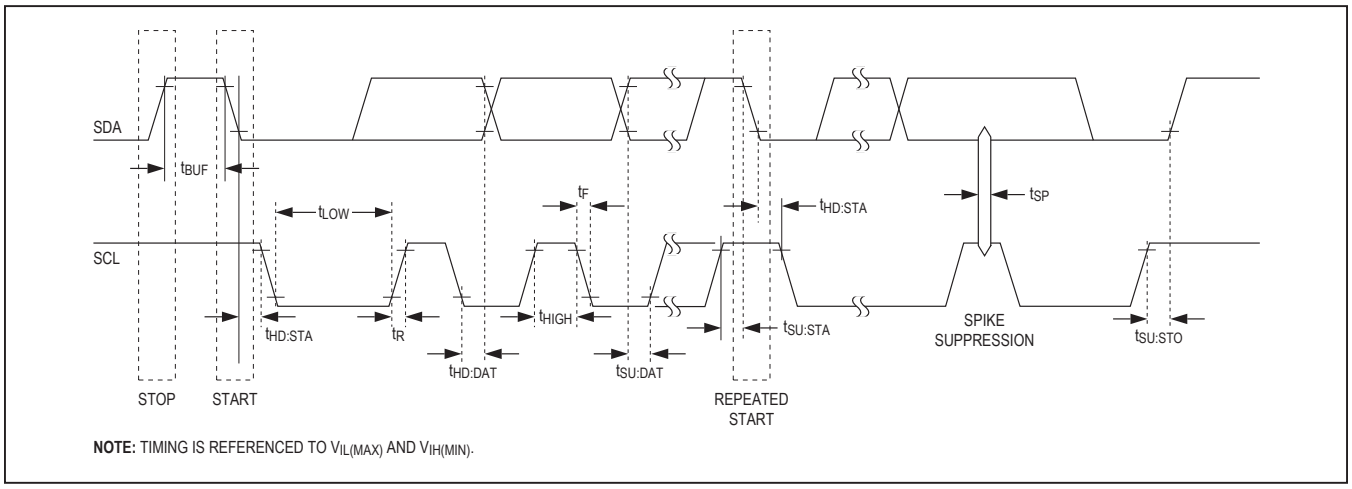


Figure 6. I²C Timing Diagram

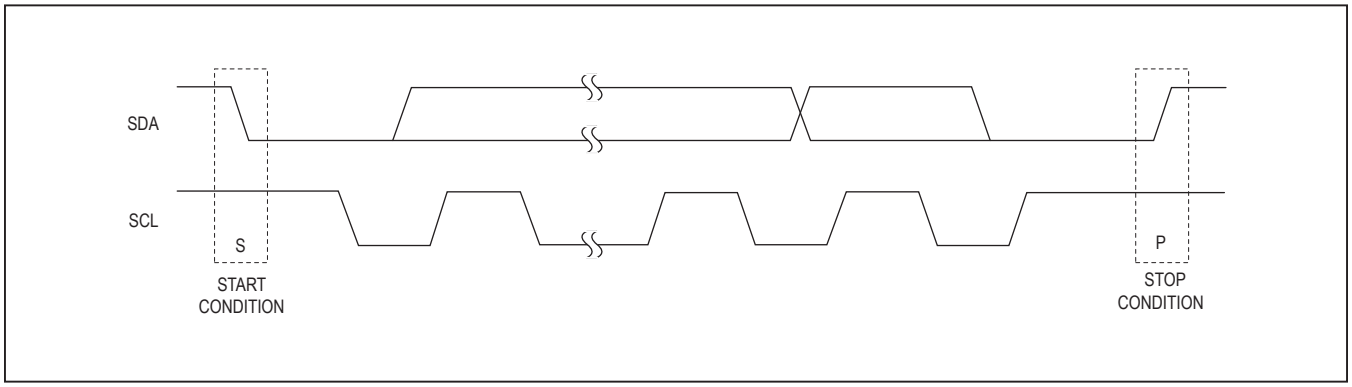


Figure 7. Start and Stop Conditions

Bit Transfer

One data bit is transferred during each clock pulse (Figure 8). The data on SDA must remain stable while SCL is high.

Acknowledge

The acknowledge bit is a clocked 9th bit (Figure 9), which the recipient uses to handshake receipt of each byte of data. Thus, each byte transferred effectively requires 9 bits. The master generates the 9th clock pulse, and the recipient pulls down SDA during the acknowledge clock pulse. The SDA line is stable low during the high period of the clock pulse. When the master is transmitting to the MAX20317, it generates the acknowledge bit because the device is the recipient. When the device is transmitting to the master, the master generates the acknowledge bit because the master is the recipient. If the device does not pull SDA low, a not acknowledge is indicated.

Slave Address

The device has a 7-bit slave address. The bit following a 7-bit slave address is the R/$\overline{W}$ bit, which is low for a write command and high for a read command. The slave address for the device is 0b00101011 for read commands and 0b00101010 for write commands. This is summarized in Table 1.

Table 1. I²C Slave Addresses

ADDRESS FORMAT	VALUE	
	HEX	BINARY
7-BIT SLAVE ADDRESS	0x15	001 0101
WRITE ADDRESS	0x2A	0010 1010
READ ADDRESS	0x2B	0010 1011

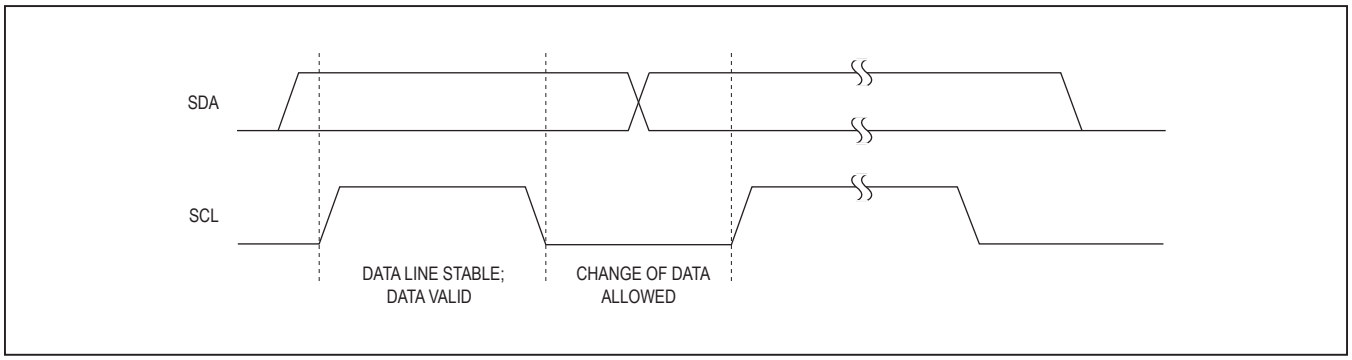


Figure 8. Bit Transfer

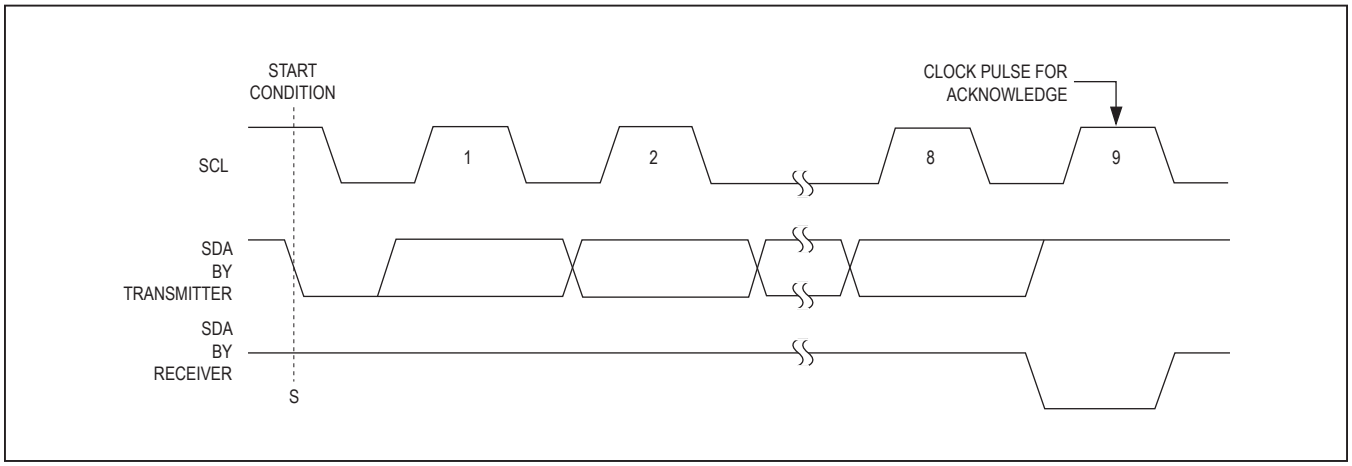


Figure 9. Acknowledge

Bus Reset

The MAX20317 resets the bus with the I2C start condition for reads. When the R/$\overline{W}$ bit is set to 1, the MAX20317 transmits data to the master, thus the master is reading from the device.

Format for Writing

A write to the MAX20317 comprises the transmission of the slave address with the R/$\overline{W}$ bit set to zero, followed by at least 1 byte of information. The first byte of information is the register address or command byte. The register address determines which register of the device is to be written by the next byte, if received. If a STOP (P) condition is detected after the register address is received, then the device takes no further action beyond storing the register address. Any bytes received after the register address are data bytes. The first data byte goes into the register selected by the register address and subsequent data bytes go into subsequent registers (Figure 10). If multiple data bytes are transmitted before a STOP condition, these bytes are stored in subsequent registers because the register addresses auto-increments (Figure 11).

Format for Reading

The MAX20317 is read using the internally stored register address as an address pointer, the same way the stored register address is used as an address pointer for a write. The pointer auto-increments after each data byte is read using the same rules as for a write. Thus, a read is initiated by first configuring the register address by performing a write (Figure 12). The master can now read consecutive bytes from the device, with the first data byte being read from the register addressed pointed by the previously written register address (Figure 13). Once the master sends a NACK, the MAX20317 stop sending valid data.

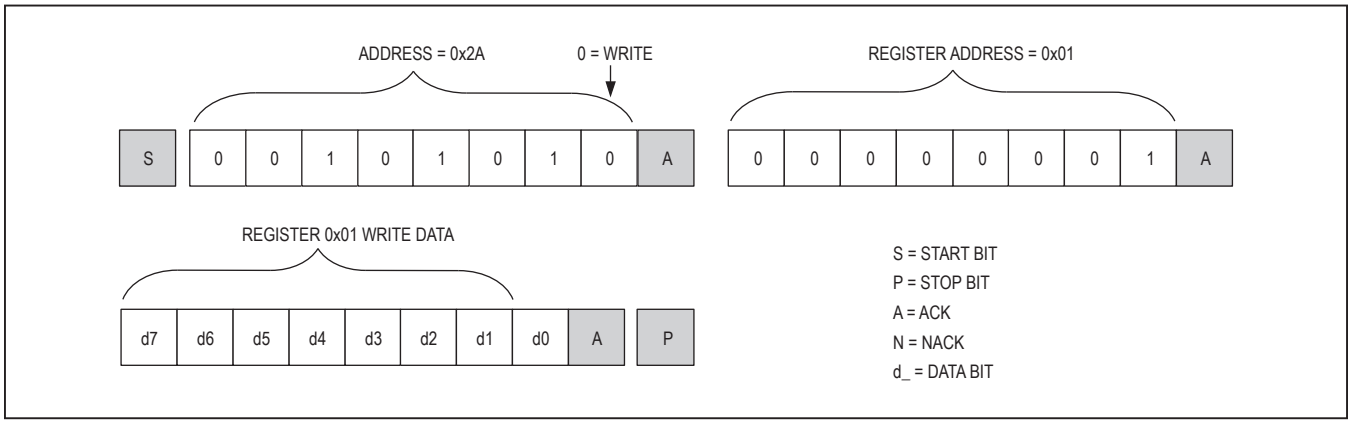


Figure 10. Format for I2C Write

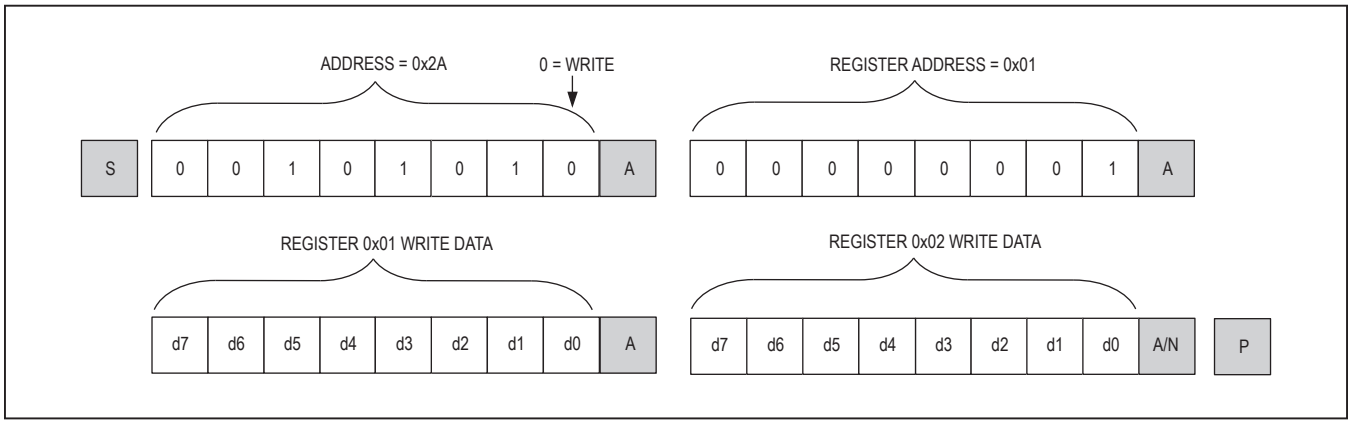


Figure 11. Format for Writing to Multiple Registers

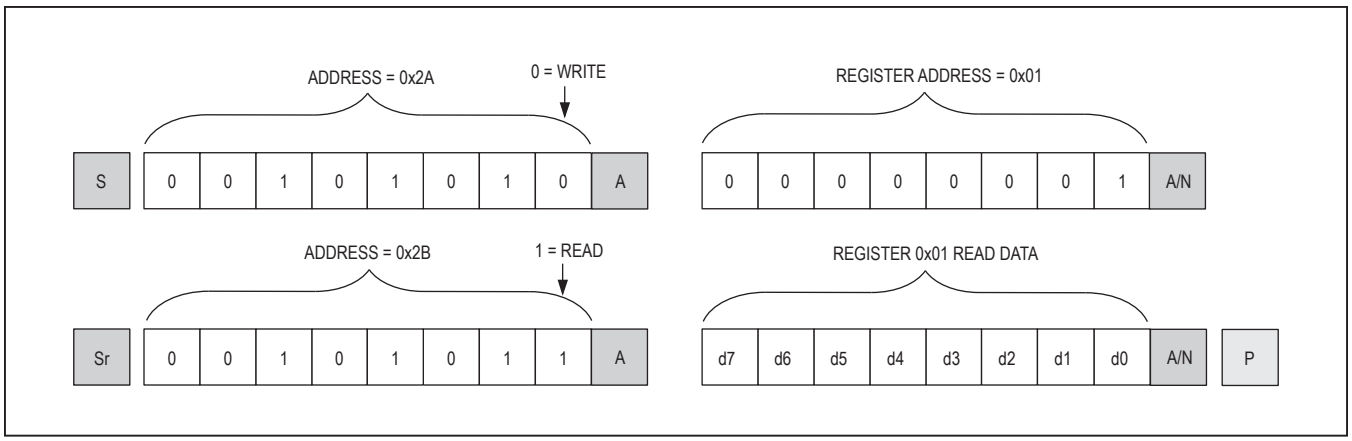


Figure 12. Format for Reads (Repeated Start)

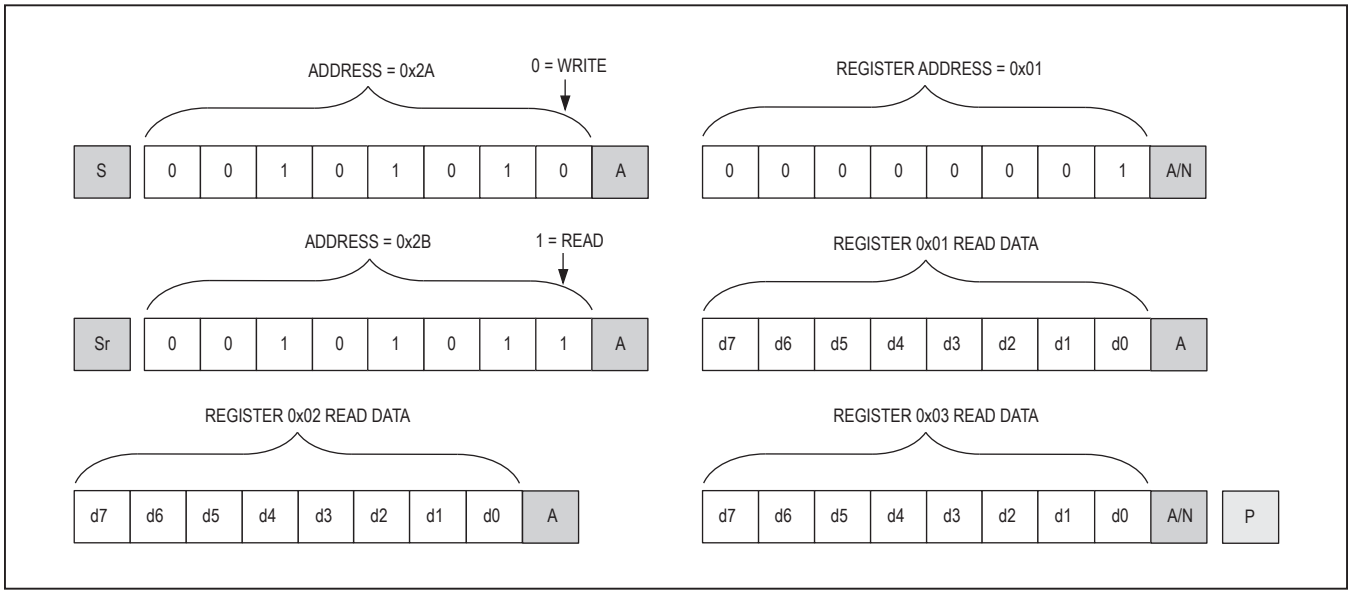


Figure 13. Format for Reading Multiple Registers

Power Line Communication

Physical Structure

In biphase mark code, high and low bits are defined by state transitions. In the MAX20317, the PLC code comprises a time unit and the low and high states of the MIC line. The time unit, t_{UNIT} defines the interval of time in which a bit is determined to be either 0 or 1. By default, t_{UNIT} = 24µs, but setting the FREQ bit (0x18[4]) HIGH increases t_{UNIT} to 30µs. A bit is considered 0 if no MIC state transition occurs during t_{UNIT}. If there is a state change, either high to low or low to high, the bit is 1.

When the MIC line is above the V_{COM_DET} threshold, a low state is recorded. Conversely, a high state is recorded when the MIC line is below the V_{COM_DET} threshold. For example, MIC line transitions and their corresponding logic values and BMC bits are shown in Figure 14.

Transmission Format

A valid PLC packet comprises a preamble, two data bytes, checksum, and postamble. The preamble is eight consecutive 1 bits. After a successful preamble, data transfer takes place until an error condition occurs or the end of transmission is reached.

Each byte of data begins with a 0 bit to indicate the start condition followed by one byte of data. A parity and stop bit are transmitted at the end of each byte. The stop bit is always 1. If parity is disabled, a parity bit of 1 will be sent, but ignored by the device.

Following the data bytes, a checksum is transmitted. The checksum is generated as NOT(DATA1 + DATA2). Transmission will end with the checksum unless the postamble is enabled. The postamble transmits 0 for a duration of 50ms. A typical data packet is shown in Figure 15.

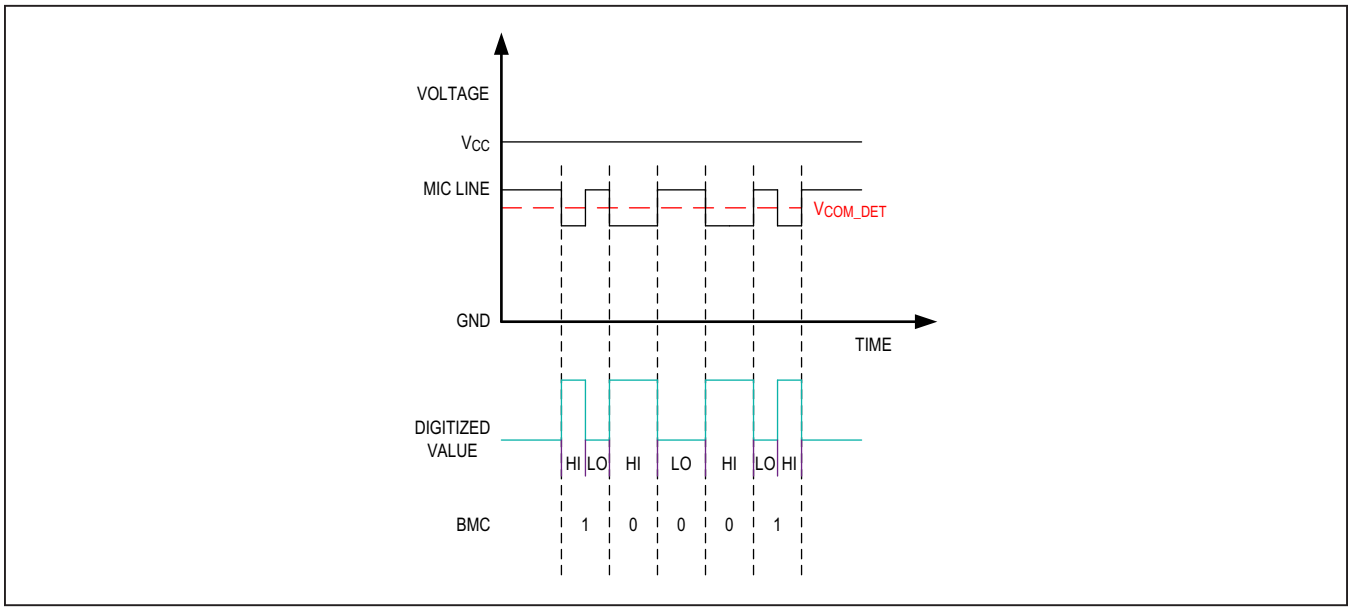


Figure 14. Determination of PLC Data Bit

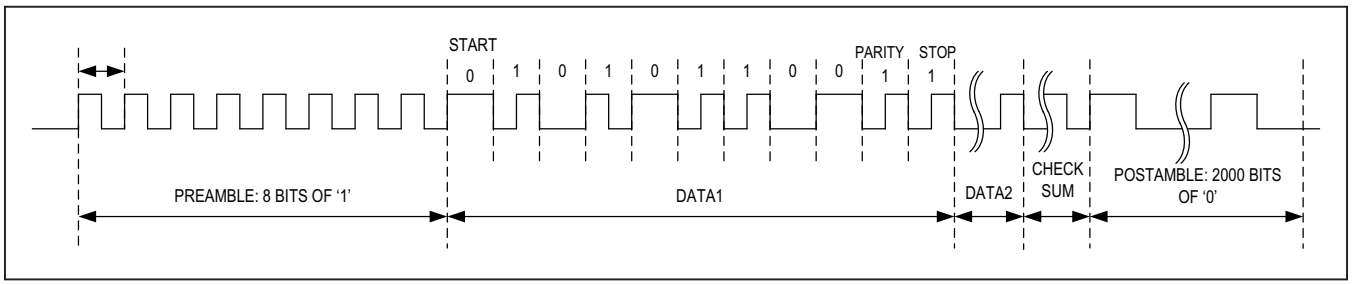


Figure 15. Sample PLC Data Packet

I²C Register Map

ADDRESS	NAME	R/W	B7	B6	B5	B4	B3	B2	B1	B0
0x00	DEVICE_ID	R	CHIP_ID[3:0]				CHIP_REV[3:0]			
0x01	ADC1_VAL	R	ADC1_VAL[7:0]							
0x02	ADC2_VAL	R	ADC2_VAL[7:0]							
0x03	STATUS1	R	IDET_LVL[1:0]		COM_DET	OPEN_ CABLE	JACK_ TYPE	DEVICE_ RDY	EOC1	EOC2
0x04	STATUS2	R	VOL_UP	VOL_ DOWN	VBOOST_ OV	MPSs	MIC_IN	SWD	DET	DETIN
0x05	STATUS3	R	ANC_HS	THT_CMP	SAR_CMP	V94_CMP	–	–	–	VOL_RFU
0x06	IRQ	R/C	SWDi	EOCi	COM_DETi	MPS/ VBOOST_ OVi	MIC_INi	DEVICE_ RDYi	DETi	DETINi
0x07	MASK	R/W	SWDm	EOCm	COM_ DETm	MPS/ VBOOST_ OVm	MIC_INm	DEVICE_ RDYm	DETm	DETINm
0x08	CONTROL1	R/W	–	DET_ DEBOUNCE	DETIN_ OVERRIDE	MIC_OUT_ DELAY	–	BYPASS	COM_THRS[1:0]	
0x09	CONTROL2	R/W	MANUAL_ G_SNS	MANUAL_ MIC_SW	MANUAL_ MG_SW	OPEN_ DETECT	FORCE_ G_SNS	FORCE_ MIC_SW	FORCE_MG_SW[1:0]	
0x0A	ADC_ CONTROL1	R/W	IDET_FLAT	JACK_TYP_ CHK_DIS	–	ADC1_ LI_CHK	ADC1_CTL[1:0]		ADC2_CTL[1:0]	
0x0B	ADC_ CONTROL2	R/W	–	–	SET_IDET[1:0]		–	ADC2_HL	FORCE_ ADC1_ START	FORCE_ ADC2_ START
0x0C	TIMING CONTROL	R/W	ADC1_AVG#[1:0]		ADC2_AVG#[1:0]		tANCDET_DEB[1:0]		tANCBPD_DEB[1:0]	

I²C Register Map (continued)

ADDRESS	NAME	R/W	B7	B6	B5	B4	B3	B2	B1	B0
0x0D	SHORT CURRENT CONTROL	R/W	FU[5:0]						tSHO_DEB[1:0]	
0x0E	HIHS_VAL	R/W	HIHS_VAL[7:0]							
0x0F	OMTP_VAL	R/W	OMTP_VAL[7:0]							
0x10	HSDET_VAL	R/W	HSDET_VAL[7:0]							
0x11	VOL0_TH	R/W	VOL0[7:0]							
0x12	VOL1_TH	R/W	VOL1[7:0]							
0x13	VOL2_TH	R/W	VOL2[7:0]							
0x14	VOL3_TH	R/W	VOL3[7:0]							
0x15	PLC_STAT	R	–	–	PLC_ TX_ERR	PLC_ TX_OK	PLC_TXP	PLC_ RX_ERR	NEW_DATA	PLC_ RX_DET
0x16	PLC_IRQ	R/C	–	–	PLC_ TX_ERRi	PLC_ TX_OKi	PLC_TXPi	PLC_ RX_ERRi	NEW_DATAi	PLC_ RX_DETi
0x17	PLC_MASK	R/W	–	–	PLC_ TX_ERRm	PLC_ TX_OKm	PLC_TXPm	PLC_ RX_ERRm	NEW_ DATAm	PLC_ RX_DETm
0x18	PLC_CON1	R/W	–	PLC_SINK	POS_ AM_DIS	FREQ	PARITY[1:0]		–	SEND_ CMD
0x19	ACC_ID	R	ACC_ID[3:0]				ACC_CAT[3:0]			
0x1A	ACC_DB1	R	ACC_DB1[7:0]							
0x1B	ACC_DB2	R	ACC_DB2[7:0]							
0x1C	ACC_ADD	R/W	ACC_ADD[7:0]							
0x1D	ACC_DATA	R/W	ACC_DAT[7:0]							