XTBM X10 Signal Meter Operation

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The XTBM displays X10 signal voltage, carrier frequency, and last decoded X10 command. It also displays powerline noise, and will indicate various types of errors that plague X10 communication, including the ubiquitous bad start code. Signal and noise levels are displayed with 10mV resolution, but the units are not displayed to pack all the information onto a single screen.

Some installations contain a repeater, such as the X10 XPCR or XTB-IIR. Some installations contain a repeater, such as the X10 XPCR or XTB-IIR. The XTBM contains a transmitter to check for a repeater whenever it is first plugged into an AC outlet, and the strength of the repeated signal will be displayed if one is active in the system. This feature allows signal levels to be quickly checked throughout a home by merely plugging the XTBM into each outlet for just a few seconds.

The XTBM will indicate the level of each X10 command that is decoded in the form Xx.xx (Vpp). When a repeater is on line, the signal strength of the original transmission is flashed onto the LCD for a fraction of a second before it is replaced by the strength of the repeated signal.

The carrier frequency of valid X10 commands is displayed in the form Fxxx (KHz). This should normally be near 120KHz. The meter can sample the range from 100KHz to 140KHz. Readings outside that range may be due to the signal not being strong enough to be accurately measured, or it may not completely fill the X10 sample window. Such is the case when using the XTB-IIR delayed transmit mode option, which should be turned off to check the XTB-IIR transmit frequency.

The frequency of sufficiently strong in-band background noise may also be displayed. Any noise source near 120KHz should be tracked down and isolated with a filter. If the XTBM cannot measure the noise frequency, it will display the number of noise cycles inside the X10 reception window for random (N) or transient (T) noise.

The XTBM samples noise in three windows: before, during, and after the X10 reception window. It displays maximum noise in the form N.xx (Vpp). Noise before the zero crossing does not affect X10 communication reliability, but it is sampled to identify Insteon commands.

Insteon commands straddle the zero crossing, and the XTBM will try to identify them as being different from other background noise. Since the XTBM does not decode the data, it is possible for sufficiently strong in-band noise straddling the zero crossing to also be identified as an Insteon command. The average level of an Insteon command (or noise mimicking an Insteon command) is displayed in the form Ix.xx (Vpp).

The XTBM includes a noise alert system that can warn about a sudden increase in the background noise level. When enabled, the XTBM will transmit “P1 ON” when the noise suddenly increases, and “P1 OFF” when it falls back to a safe level. There is a slight delay so a momentary transient does not cause an alert.

Since the noise level may corrupt nearby X10 communication, the alert function is most useful with the monitoring device located remotely from the noise source. If you suspect an intermittent noise source, plug the XTBM into the same circuit, and have the monitoring device on another circuit.

The noise alert system can be enabled or disabled by plugging the XTBM in while holding down the key of a manual controller sending “P ON” or “P OFF”. The state of the noise alert system is only displayed when it is changed. The noise alert is disabled after running a self-test by sending “P ALL_OFF” during power-up. The noise alert status is stored in non-volatile memory, but it will be disabled if the self-test is rerun either by a manual command or from the watchdog timer going off.

Inadequate signal strength and powerline noise often cause X10 reliability problems. The XTBM should provide the information you need to efficiently troubleshoot your X10 system.

Decoded commands:

Label	Code	X10 Function	Label	Code	X10 Function
AOFF	0000	ALL Units OFF	HReq	1000	Hail Request
ALON	0001	ALL Units ON	HAck	1001	Hail Acknowledge
ON	0010	ON command	PDim	1010	Preset Dim "0" bit
OFF	0011	OFF command	PDim	1011	Preset Dim "1" bit
DIM	0100	DIM command	Xdat	1100	Extended Data
BRT	0101	BRIGHT command	StON	1101	Status ON
LOFF	0110	ALL Lights OFF	StOF	1110	Status OFF
Xcod	0111	Extended code	StRq	1111	Status Request

Status indications:

MONITOR	The unit is monitoring the powerline.
<VALID>	A valid X10 command has been decoded (displayed for 2 seconds).
ERR RCV	An error was detected while trying to decode a X10 command.
ERR BSC	A bad start code was received.
ERR COL	A collision was detected while trying to decode a X10 command.
^NOISE^	Noise may be corrupting weaker X10 signals.
INSTEON	Noise may be due to an Insteon transmission.

Full line messages:

REPEATER ON LINE	The signal level displayed is from a working repeater.
HIGH NOISE LEVEL	Background noise may be high enough to corrupt X10 transmissions.
NOISE DECREASE	Background noise has decreased to an acceptable level.
NOISE ALERT ON	The P1 ON/OFF noise alert system is enabled.
NOISE ALERT OFF	The P1 ON/OFF noise alert system is disabled.
FAIL SELF TEST	The transmitter is not working right or something is loading it down.

Debugging with the XTBM:

The XTBM makes it easy to identify "signal suckers" and major noise sources. If the house has a repeater, just plugging in the XTBM will give a measurement of the signal level at that outlet. Without a repeater, I recommend a TM751 or RR501 located on the same circuit as your main controller, triggered with a PalmPad. With the XTBM plugged into the outlet under test, send a few commands, and the XTBM should display the X10 signal amplitude and decode the commands.

X10 reliability begins to suffer at signal levels below 100mV. Unplug potential "signal suckers" and monitor the change in signal level. Any devices that cause a significant change in signal levels when unplugged should be isolated with X10 filters.

Noise is also a major problem today. It is possible for “in band” noise of only 50mV to cause serious reliability problems for X10 modules that do not have some form of AGC. Whenever the noise reads more than .02 or .03, or there are a series of ERR BSC readings, it is worth spending the time to track down and isolate the cause. Some types of interference may corrupt X10 commands, causing them to look like noise. That can cause the noise to increase when X10 commands are sent.

Move around the circuit looking for the highest noise level. If that points toward the distribution panel, the noise source may be on another circuit. If the noise level increases as you move away from the distribution panel, the noise source is likely on the circuit you are testing. Turn off potential noise sources while watching for the noise level. Like with "signal suckers" strong noise sources should also be isolated with an appropriate filter. An alternative is to use the XTB-ANR on that circuit.