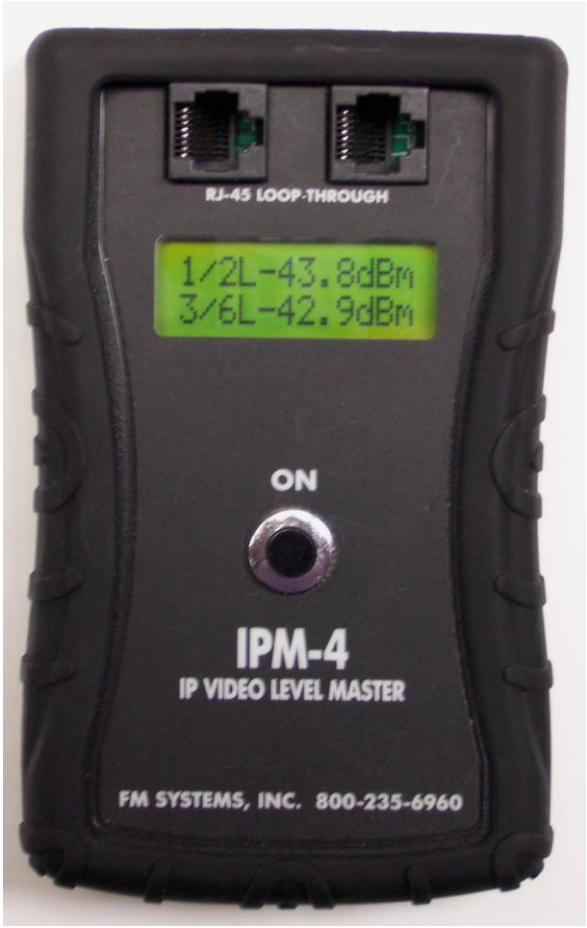
IPM-4



IP VIDEO LEVEL MASTER

INSTRUCTION BOOK
IB6468-01

IPM-4
IP VIDEO LEVEL MASTER

DESCRIPTION:

The IPM-4 digital video level master is used to measure the signal quality of your IP video network. This low cost meter makes 6 different level measurements to give you assurance that your IP video system is working within specifications. It measures the output levels of both the camera and the recorder end of the system in dBm so you can check the near-end and far-end signal levels simultaneously. The meters unique design also measures the amount of amplitude imbalance in percent that exists on both the sending and receiving channels which contributes to cross-talk and increases the bit error rate in your digital video. It also measures the level of Common Mode signal in dB, a form of interference caused by phase and amplitude variations that also causes video failure.

Use this meter to verify correct equipment signal levels and interference levels in the cable on any IP video network before you leave the jobsite. Do your work with the assurance that all equipment levels in the system are correct and that the cable losses are within allowable limits. If you are not measuring your levels now, you should be, you need one of these meters so you can do all your IP video jobs with the confidence of knowing the levels are correct.

The meter measures the network levels without loading the data lines and will work with all P.O.E. signals. Simply loop the IP video signal through the meter and press the ON button and the LCD display will read out the levels that exist on data lines 1-2, & 3-6 in dBm simultaneously. Next the LCD displays the amount of imbalance that exists on the cable in tenths of a percent. Equipment output imbalance and cable imbalance will be measured on each wire pair 1-2, & 3-6. Then the LCD will display the amount of Common Mode signal in dB that exists within the IP video signal.

Use this meter on repair jobs to instantly access the source of intermittent or non-responsive IP video systems. You can immediately determine if the problem is an equipment problem or a cable problem without having to swap out equipment or mess with the cables and you will save hours of trial and error. Near lightning strikes can damage the output of an IP camera or NVR and go un-detected causing the video to go intermittent, but with this meter you can measure the output level, balance, and common mode of the system in seconds to determine if the equipment has been affected and which end of the system needs your attention. Measuring signal levels is a vital step in knowing your IP installation meets the standards.

When you make measurements you can offer to give your customers a “QUALITY ASSURANCE JOB RECORD” detailing the system operating levels for a “Proof of Performance” document and in this way you will be able to offer the client more than your competitors. The offer of a Proof of Performance document also looks good on government bids because it shows a level of expertise that will help you to win the bid. If you don’t have one, order the IP Video Level Master today and do your next job with confidence.

DISPLAY:

The unit uses a two line 2 X 12 character LCD to display the measurements. The IP video power Level for wires1-2 are viewed on the upper line of the display indicated by an "L" following the 1/2 like this "1/2L", while the IP video power levels for wires 3-6 are viewed on the lower line of the display indicated by an "L" following the 3/6 like this "3/6L". The "L" is for LEVEL and the power measurements are displayed in dBm. After a few moments the LCD displays switches to display the signal Balance on lines 1-2 and 3-6 again with the two display lines simultaneously. The upper line is marked '1/2B and the lower line is marked "3/6B" the "B" is for Balance and it measures the signal imbalance in percentage (%). Next the meter displays the Common Mode signal measured on both 1/2 and 3/6 with a "CM" that denotes Common Mode and the readings are in dB, it is this signal that most affects the bit error rate and is one of the main causes of video loss. The display also measures the battery voltage and lets you know when a battery is getting low and needs replacement. When a battery is below operational range the display will alert you to change the battery.

Power level measured in dBm

Signal level Balance in dB

Common Mode measured in dBm

Low battery indication

Battery replacement reminder

READINGS:

When using this meter it is a good practice to use a straight network jumper cable to allow you to loop the IP Video signal through the meter. Looping the IP Video signal though the meter is the only way to get the camera and the NVR to put out the correct signals for measurement, both ends must be communicating to take readings. By using a straight network jumper cable to connect to the local equipment the IPM-4 will know what end of the system is near end and which end is the far end. You can use a reverse cable but the readout will be reversed as well making the near end read as the far end and so on. After connecting the straight network jumper cable between the meter and the equipment and then connecting the original cable that goes to the other end of the system to the meter you are ready to take readings. The camera signal and all P.O.E. will pass through the meter even when the power is not on the meter. This meter is a signal sniffer that takes reading from the line without loading it or causing the level being measured to change as a result of connecting the meter.

LEVEL (near end).

The "1-2L" level reading is a reading of wires 1 and 2 the near end of the system, the end that you are closest to when you take the reading. This reading is calibrated in dBm and a level of +12 dBm is equal to the standard. At the near end measuring the near end equipment output this level should have no loss to speak of and the number readout represents the equipment output level. The tolerance for this reading according the ANSI X3.263 is +/-0.45 dB.

LEVEL (far end).

The "3-6L" level reading is the reading of wires 3 and 6 the far end of the system. This is the level that has traversed the distance of the connecting cable to reach the receiver end of the system. Since the system has a reversal cable between the camera and the NVR this signal arrives on wires 3 and 6 with all of the loss associated with the cable. This level is directly related to the cable length and quality of manufacture of the cable. Also because different cable types "Cat-5, Cat-6, Cat-6e" have different wire gages and different loss characteristics this reading will very greatly. You can expect reading like +5dBm with 100 meters of Cat-6e and in general these kinds of losses are acceptable. The maximum tolerance for the far end reading is dependent on the sensitivity of the receiver equipment and in no small part to the type and quality of the cable used. You will get to know what your equipment can handle with some experimentation. To convert from dB to Volts peak to peak see the table on the next page.

100 OHM dBm CONVERSION TABLE:

100 Ohm dBm Conversion Table							
dBm	V p-p	V rms	mW	dBm	V p-p	V rms	mW
20	8.944271910	3.162277660	100.000000000	-20	0.089442719	0.031622777	0.010000000
19	7.971590731	2.818382931	79.432823472	-21	0.079715907	0.028183829	0.007943282
18	7.104687717	2.511886432	63.095734448	-22	0.071046877	0.025118864	0.006309573
17	6.332059593	2.238721139	50.118723363	-23	0.063320596	0.022387211	0.005011872
16	5.643454053	1.995262315	39.810717055	-24	0.056434541	0.019952623	0.003981072
15	5.029733719	1.778279410	31.622776602	-25	0.050297337	0.017782794	0.003162278
14	4.482754895	1.584893192	25.118864315	-26	0.044827549	0.015848932	0.002511886
13	3.995259506	1.412537545	19.952623150	-27	0.039952595	0.014125375	0.001995262
12	3.560778783	1.258925412	15.848931925	-28	0.035607788	0.012589254	0.001584893
11	3.173547431	1.122018454	12.589254118	-29	0.031735474	0.011220185	0.001258925
10	2.828427125	1.000000000	10.000000000	-30	0.028284271	0.010000000	0.001000000
9	2.520838328	0.891250938	7.943282347	-31	0.025208383	0.008912509	0.000794328
8	2.246699525	0.794328235	6.309573445	-32	0.022466995	0.007943282	0.000630957
7	2.002373059	0.707945784	5.011872336	-33	0.020023731	0.007079458	0.000501187
6	1.784616868	0.630957344	3.981071706	-34	0.017846169	0.006309573	0.000398107
5	1.590541458	0.562341325	3.162277660	-35	0.015905415	0.005623413	0.000316228
4	1.417571566	0.501187234	2.511886432	-36	0.014175716	0.005011872	0.000251189
3	1.263411988	0.446683592	1.995262315	-37	0.012634120	0.004466836	0.000199526
2	1.126017120	0.398107171	1.584893192	-38	0.011260171	0.003981072	0.000158489
1	1.003563814	0.354813389	1.258925412	-39	0.010035638	0.003548134	0.000125893
0	0.894427191	0.316227766	1.000000000	-40	0.008944272	0.003162278	0.000100000
-1	0.797159073	0.281838293	0.794328235	-41	0.007971591	0.002818383	0.000079433
-2	0.710468772	0.251188643	0.630957344	-42	0.007104688	0.002511886	0.000063096
-3	0.633205959	0.223872114	0.501187234	-43	0.006332060	0.002238721	0.000050119
-4	0.564345405	0.199526231	0.398107171	-44	0.005643454	0.001995262	0.000039811
-5	0.502973372	0.177827941	0.316227766	-45	0.005029734	0.001778279	0.000031623
-6	0.448275490	0.158489319	0.251188643	-46	0.004482755	0.001584893	0.000025119
-7	0.399525951	0.141253754	0.199526231	-47	0.003995260	0.001412538	0.000019953
-8	0.356077878	0.125892541	0.158489319	-48	0.003560779	0.001258925	0.000015849
-9	0.317354743	0.112201845	0.125892541	-49	0.003173547	0.001122018	0.000012589
-10	0.282842712	0.100000000	0.100000000	-50	0.002828427	0.001000000	0.000010000
-11	0.252083833	0.089125094	0.079432823	-51	0.002520838	0.000891251	0.000007943
-12	0.224669953	0.079432823	0.063095734	-52	0.002246700	0.000794328	0.000006310
-13	0.200237306	0.070794578	0.050118723	-53	0.002002373	0.000707946	0.000005012
-14	0.178461687	0.063095734	0.039810717	-54	0.001784617	0.000630957	0.000003981
-15	0.159054146	0.056234133	0.031622777	-55	0.001590541	0.000562341	0.000003162
-16	0.141757157	0.050118723	0.025118864	-56	0.001417572	0.000501187	0.000002512
-17	0.126341199	0.044668359	0.019952623	-57	0.001263412	0.000446684	0.000001995
-18	0.112601712	0.039810717	0.015848932	-58	0.001126017	0.000398107	0.000001585
-19	0.100356381	0.035481339	0.012589254	-59	0.001003564	0.000354813	0.000001259
				-60	0.000894427	0.000316228	0.000001000
	dBm @ 100 Ohms						
	V p-p = Volt Peak to Peak						
	V rms = Volts RMS						
	mW = Milli-Watts						

BALANCE (near end).

The "1/2B" Balance reading is the reading of the balance on wires 1 and 2 at the near end of the system where you are taking the reading. This balance is the level of the signal on each wire relative to the local equipment ground and since the IP video system is supposed to be balanced to prevent common mode interference and cross-talk it is a good idea to look at this measurement. A perfect reading for this balance would be 0.0 % meaning no imbalance of the signal at all. However all systems will exhibit some imbalance built into the equipment itself. The tolerance for this measurement is +/- 2.0 %. It should be noted that lightning storms can cause damage to the equipment without destroying it. When this happens a level drop will occur on the output and more noticeably a wild imbalance will occur at one or both ends of the system.

BALANCE (far end).

The "3/6B" Balanced reading is the reading of the balance on wires 3 and 6 from the far end. This reading will carry the imbalance from the output of the far end equipment and also the imbalance caused by the network cable itself. Again a perfect reading would be 0.0 % however is will be more likely that a higher reading could be measured because the cable imbalance is added to the equipment output imbalance. The tolerance is the same as the near end +/- 2 %.

COMMON MODE (near end).

The "1-2CM" Common Mode reading is the amount of imbalance on wires 1 and 2 caused by imbalances in the Phase and Amplitude of the equipment output where you are taking the reading. This reading can account for the majority of signal loss not related to pure resistance losses. This measurement will show imbalance of the capacitive and inductive loading effects on the near end equipment output. A good level should be no less than -35.0 dB. However a level of -42 dB or higher would be expected on most systems.

COMMON MODE (far end).

The "3-6CM" Common Mode reading is the amount of imbalance on wires 3 and 6 caused by imbalances in the Phase and Amplitude of the far end output equipment and to a large degree the cable quality of the network cable spanning the distance from camera to NVR. Similarly the readings should be no less than – 35 dB and a measurement of -42 dB or higher would be expected on most systems. Network cable quality of manufacture is a major factor in this reading as the cable imbalance caused by non-uniform irregularities in the cable allow for un-equal capacitance and inductance in the cable. The non-uniformity of rate of twist is also a major factor in choosing a good cable over lesser cables. The price does no always make a good cable. It is important to measure your system and over time you will discover the best manufacturer for the price.

You can usually get all the information you need from one end of the system say at the NVR end of the system or the camera end of the system.

However if you get readings that are close to being out of tolerance you should measure both ends of the system and compare the readings. The readings for one end of the system should match the other end of the system by a few points. If they do not then you should investigate further to discover what part of the system is causing the out of spec readings and resolve the issue. At the back of this book there is a page with the "IP VIDEO QUALTIY ASSURANCE JOB RECORD" on it. Copy this page and use it to record the reading on your job. You can even give the customer a copy of this after the job is complete.

BATTERY LOW (display).

When the battery runs down and is about 6.8 Volts under load with the unit tuned on working this display will come on for approximately 2 seconds. It will come on each time you depress the "ON" button to turn on the unit to warn you that the battery will need to be replaced soon.

REPLACE BATTERY (display).

When the battery is discharged and the terminal voltage reaches 6.2 Volts under load with the unit tuned on and working this display will come on and stay on until you release the "ON" button or the battery is replaced. At this point you must supply a fresh battery for proper operation.

INPUT SIGNALS AND CONNECTORS:

This meter is equipped with two 8P8C (RJ-45) female connectors and one push button control for ease of use. The two 8P8C connectors are straight through and have a high impedance loop through input to allow the camera signal to establish communications with the DVR receiver and produce a signal to be measured without loading the signal. A ground lead Banana jack at the top front of the unit can be used with the supplied ground lead for greater accuracy on the Balance and Common Mode tests. Once you have connected the IP video signal, you just push the button and the readings begin to appear on the LCD screen.

GROUND LEAD:

The meter is equipped with a ground clip lead and plug for high accuracy measurements of the signal Balance and Common Mode signals. When a local ground from the camera or NVR is available the banana plug on the clip lead set supplied with the meter should be plugged into the top front banana socket and the other end of the lead connected to the ground on the camera or NVR. If you are at the camera you would use the camera ground or any exposed conducting metal on the camera. If you are at the NVR end of the system then use any conducting metal point on the NVR. CAUTION: Never connect this ground lead to the ground pin of a power outlet. Use only the terminal equipment the camera or the NVR for this connection. When this lead is connected the readings on "Balance", and "Common Mode" should improve by several tenths of a dB or %. The Level measurements will be un-affected.

BATTERIES:

A battery compartment door allows easy access to the 9 Volt battery that powers the device. One alkaline 9 Volt "transistor" battery is used. If the unit will not power up the battery must be replaced by a fresh 9 Volt battery.

The unit will also let you know when the battery is beginning to run low so you can get another battery before it runs out. The battery is located in the case with access provided by a sliding plastic cover plate that has an arrow printed on it. Slide in the direction of the arrow to open. When replacing the cover, place it flat into the grooves so that both ends engage when closing.

ENCLOSURE:

The comfort grip hand-held case is made of flame retardant ABS plastic with a flame rating of 94-5VA. The meter comes with an impact resistant rubber boot to protect it during daily use. Warning: The meter case is not waterproof and must be kept out of rain and away from all other sources of liquids.

CARE AND MAINTENANCE:

No routine maintenance or test procedures are required other than battery replacement. Attempts at field repair or adjustment will void the warranty.

The IPM-4 is a precision measuring instrument and should be treated accordingly. While it can withstand ordinary everyday use, it should not be left outside in the rain or otherwise mistreated. It is not waterproof. The battery should be removed if it is placed into storage to prevent leakage of corrosive fluids from batteries as they discharge and age in storage.

Replace batteries at least once a year even if ordinary use does not discharge the battery because old batteries may leak and cause corrosion damage. If the IPM-4 fails to operate even after battery replacement, or does not read a known IP video signal correctly, call the factory for a Return Authorization Number and return it to the factory for repair.

AUXILIARY EQUIPMENT:

The MC1, MC2, and MC3 are Protective Carry Cases to house and protect the IPM-4 and your other test meters while being transported. These are very rugged water resistant ABS cases with foam-lined interiors suitable for transporting this meter and other test equipment. You can order these carry cases as an option.

MORE INFORMATION ABOUT MEASUREMENTS:

IP video network cables typically use two out of four wire pairs to send the digital picture information in both directions forming a two way communications path. In most network cables like Cat 5 and Cat 6 these wires are not positively shielded from the outside world or even from each other as are other cables with shields around individual pairs of wires. The only isolation provided by a network cable to keep the two signals separated is the wire insulation and the fact that the wire pairs are individually and synchronously twisted together. Also with some grades of network cable a physical separator is added to keep the wire pairs a precise distance apart and give strain relief to the cable. This separator also resists sharp bends, stretching, and positional distortion of the wires inside the cable.

An IP video system has a balanced digital signal with an equal but opposite polarity on each wire at all times. That means that when the signal is going positive on one wire, the opposite wire is going negative with respect to it at precisely the same time with the exact same amplitude.

The IP video delivery system relies on this precise balance to transmit its signals over twisted pair wires. Any imbalance in this signal will cause a form of interference called “Common Mode interference”. Common Mode signals are signals that have the same phase and amplitude on each wire at the same time hence the name “Common Mode”. Any part of the original signal that reaches the receiver as a common mode signal will be canceled and can be counted as signal loss.

Common Mode interference signals can originate from the output terminal equipment due to small variations in the driving impedance or termination impedance of each side of the balanced output, or it can be created in the network cable itself. It takes time for a digital signal to get from one end of a wire to the other end, at approximately 68% the speed of light and it is possible for one wire to deliver its signal slightly faster than the other wire due to inductance and capacitance variations in the two wires themselves. If both wires do not have the same propagation delay then some of the differential signal will be transformed into a common mode signal and radiate out of the cable like an antenna creating cable loss, or into other wires in the cable creating cross-talk.

In the network cable it is the rate of wire twist, uniformity of twist, and the physical positioning of the twists relative to one another that contribute most to the balance and also shielding effect within the cable. Each of the wire pairs has a different twist ratio or number of turns per meter and if the originating signal is properly balanced most of the signal will stay in the wire pair and not couple into other wire pairs or radiate out to create common mode signals.

Near-End/Far-End cross-talk does seriously interferer with digital transmission and can cause the signal to fail due to excessive bit error rate regardless of length of the network cable. Connector termination onto the cable is the greatest contributing factor in this type of cross-talk.

When wire pairs are not twisted together and are run straight and parallel as they do when they run through a crimp-on connector the chances of increased cable loss are multiplied. Also particularly on long runs when there is great signal attenuation due to cable length, the Near-End wire pair with the strong signal talks into the Far-End wire pair that has the attenuated signal on it.

Care should be taken to keep the straight wire connector preparation length to a minimum. These physical properties of a network cable prevent coupling between the two wire pairs and the resultant cross talk that degrades the signal path.

All network cables are not created equally. Price and availability should not be the only factors used in the purchase of this kind of network cable. During the manufacturing of this cable, the precise diameter of the wire gage and the concentricity of the insulation around the each wire over the length can contribute to increased loss in the wire pairs due to common mode and also cross-talk that creates higher bit error rates in the data.

Also holding the wire twist rate and repeatability of twist to an exacting standard is crucial in a low loss cable. Besides the individual twists on each wire pair, there is also a carefully controlled twist of all the pairs together to form a cable that when bent does not change the relative positions of the wire pairs. This is also the reason network cable has a minimum bend radius that should never be exceeded. When you are shopping for a manufacturer of cable and you find a good one, stick with them, cable manufacturing quality varies widely in the marketplace. The distance you can go with one manufacturer may not work with another manufactures product.

Lightning strikes and ground loops can also change the common mode effects in an already installed system. A nearby lightning strike can cause a voltage surge between the camera and the recorder that can in the blink of an eye permanently damage the output impedance of the network camera or its recorder. What happens is the output drive on either or both terminals responds to the surge by blowing some of the resistive element off of the driving resistors in the equipment. This causes a permanent change in the output impedance that will create a greater common mode signal loss and if your cable length is near the limits you will get a failure of the system.

Similarly any ground loop voltage caused by a 60 Hz differential ground voltage will slowly cook the output resistors and cause the same kind of failure over a longer period of time. Basically anything that changes the capacity and conductivity of the network cable will affect the basic loss in the camera system. Water entering the cable will affect the capacity of the insulation and it will get to the copper wire and soon corrode the wire causing catastrophic losses to occur.

Humidity and temperature changes also affect the signal losses within the network cable. Temperature variation causes a small daily deviation in the resistance of the wire due to the conductivity of the copper wire changing with temperature. However humidity will cause water to enter the cable and stay there permanently degrading the cable.

Many conditions relating to the mechanical handling of the network cable during installation can significantly increase the common mode and crosstalk problems substantially. Here are some of them:

1. Kinking the cable, stretching the cable, squashing the cable or stepping on it, and bending the cable tighter than the minimum bend radius.
2. Liquid intrusion into the network cable, since all the water never completely dries out causing the cable to exhibit a higher capacity and then corrosion will eventually eat the cable in time.
3. Excess heat can alter the cables insulation and deform the positions of the wires relative to one another.

In general the network cable must be handled very gently during installation to prevent the generation of common mode signals and cross-talk that will ultimately reduce your maximum distance limitation and could cause failure of the system in time. It is recommended that all installations be measured for signal level, cross-talk, and common mode when the system is complete so that the installers will know the system is free of serious faults before they leave the jobsite.

The IPM-4 IP Video Level Master is a low cost meter that will measure signal level amplitude in dBm, signal balance in %, and Common Mode signal loss in your IP camera system in dB. Simply connect the IP video signal to the meter and read the signal levels in dBm, the signal balance in %, and the common mode loss in dB. It measures the Near-End and Far-End signal levels in dBm and simultaneously displays them on an LCD display. Use this meter to check your equipment output levels and the delivered cable signal levels.

IP VIDEO QUALITY ASSURANCE JOB RECORD

Measured with IPM-4 IP VIDEO MASTER

DATE: LOCATION:

JOB NUMBER: TESTED BY:

LOCATION	CAMERA END						NVR END					
MEASUREMENT	LEVEL		BALANCE		COMMON MODE		LEVEL		BALANCE		COMMON MODE	
WIRE PAIRS	1-2 PAIR	3-6 PAIR	1-2 PAIR	3-6 PAIR	1-2 PAIR	3-6 PAIR	1-2 PAIR	3-6 PAIR	1-2 PAIR	3-6 PAIR	1-2 PAIR	3-6 PAIR
STANDARD	+ 12 dBm	+ 12 dBm	0.0 %	0.0 %	MINIMUM	MINIMUM	+ 12 dBm	+ 12 dBm	0.0 %	0.0 %	MINIMUM	MINIMUM
TOLERANCE	+/- 0.45 dB	+ 5 dBm	+/- 2.0 %	+/- 2.0 %	- 35.0 dB	- 35.0 dB	+/- 0.45 dB	+ 5 dBm	+/-2.0 %	- 7.0 dB	- 35.0 dB	- 35.0 dB
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